

2004 Chevrolet S10 Pickup

2004 DRIVELINE/AXLES Rear Drive Axle - Blazer/S10, Jimmy/Sonoma

2004 DRIVELINE/AXLES

Rear Drive Axle - Blazer/S10, Jimmy/Sonoma

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Bearing Cap Bolts	75 N.m	55 lb ft
Differential Housing Cover Bolts	39 N.m	29 lb ft
Drain Plug	33 N.m	24 lb ft
Fill Plug	33 N.m	24 lb ft
Pinion Shaft Lock Bolt	25 N.m	18 lb ft
Ring Gear Bolts	120 N.m	89 lb ft
Vent Clamp Bolt	17 N.m	13 lb ft

AXLE PRELOAD AND BACKLASH SPECIFICATIONS

Axle Preload and Backlash Specifications

Application	Specification	
	Metric	English
Backlash	0.08-0.25 mm	0.003-0.010 in
Backlash (Preferred)	0.13-0.18 mm	0.005-0.007 in
Pinion Bearing Preload, New Bearings	1.7-3.4 N.m	15-30 lb in
Pinion Bearing Preload, Used Bearings	1.1-2.3 N.m	10-20 lb in
Pinion and Differential Case Bearing Preload, New Bearings	3.4-6.2 N.m	30-55 lb in
Pinion and Differential Case Bearing Preload, Used Bearings	2.8-5.1 N.m	25-45 lb in

SEALERS, ADHESIVES, AND LUBRICANTS

Sealers, Adhesives, and Lubricants

Application	Type of Material	GM Part Number
Rear Drive Axle - with RPO G80	Lubricant	1052271 only
Rear Drive Axle - without RPO G80	Lubricant	1052271 or SAE 80W-90 GL5
Pinion Yoke Splines	Sealant	12346004 or equivalent

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COMPONENT LOCATOR

REAR AXLE DISASSEMBLED VIEWS

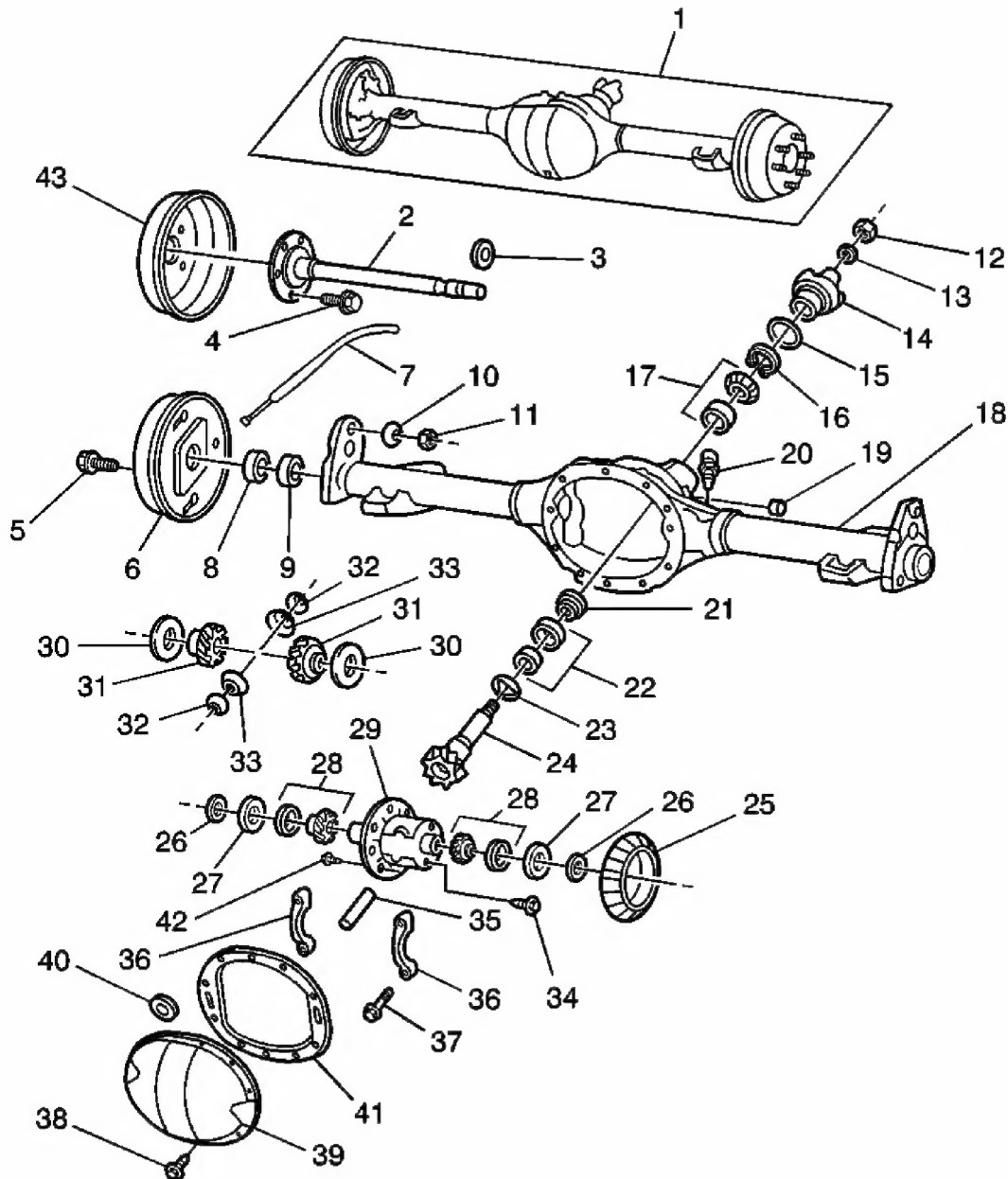


Fig. 1: Rear Drive Axle Disassembled View
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 1

Callout	Component Name
1	Rear Drive Axle Assembly

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2	Rear Axle Shaft
3	Rear Axle Shaft Lock
4	Rear Wheel Stud
5	Brake Backing Plate Bolt
6	Brake Backing Plate
7	Park Brake Cable
8	Wheel Bearing Stud
9	Wheel Bearing
10	Washer
11	Hex Nut
12	Pinion Gear Nut
13	Pinion Gear Washer
14	Yoke
15	Deflector
16	Seal
17	Pinion Gear Bearing
18	Rear Axle Housing
19	Fill Plug
20	Vent Connector
21	Spacer
22	Pinion Gear Inner Bearing
23	Shim Kit
24	Pinion Gear
25	Ring Gear
26	Differential Bearing Shim Kit
26	Differential Bearing Shim Kit
27	Differential Bearing Spacer
27	Differential Bearing Spacer
28	Differential Bearing
28	Differential Bearing
29	Differential Case
30	Differential Side Gear Washer
30	Differential Side Gear Washer
31	Differential Side Gear
31	Differential Side Gear
32	Differential Pinion Gear Washer
32	Differential Pinion Gear Washer
33	Differential Pinion Gear Kit
33	

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	Differential Pinion Gear Kit
34	Differential Pinion Gear Shaft Bolt
35	Differential Pinion Gear Shaft
36	Differential Bearing Cap
36	Differential Bearing Cap
37	Hex Bolt
38	Differential Cover Bolt
39	Rear Axle Housing Cover
40	Rear Axle Housing Chip Magnet
41	Gasket
42	Differential Ring Gear Bolt
43	Rear Brake Drum

DIAGNOSTIC INFORMATION AND PROCEDURES

DIAGNOSTIC STARTING POINT - REAR DRIVE AXLE

Begin the system diagnosis by reviewing the system Description and Operation. Reviewing the Description and Operation information will help you determine the correct symptom diagnostic procedure when a malfunction exists. Reviewing the description and Operation information will also help you determine if the condition described by the customer is normal operation. Refer to **Symptoms - Rear Drive Axle** in order to identify the correct procedure for diagnosing the system and where the procedure is located.

SYMPTOMS - REAR DRIVE AXLE

Review the system and operation in order to familiarize yourself with the system functions. Refer to **Rear Drive Axle Description and Operation**.

Rear Axle Noise

The proper diagnosis is an important part of rear axle repair. In axle work, one of the most difficult conditions to diagnose is noise. Locating a broken axle shaft or broken differential gear presents little or no problems, but locating and isolating axle noise can be an entirely different matter.

Any gear driven unit, especially an automotive drive axle where the engine torque multiplication occurs at a 90 degree turn in the driveline, produces a certain amount of noise. Therefore, an interpretation must be made for each vehicle in order to determine where the noise is normal or if a problem actually exists. A certain amount of noise must be expected and cannot be eliminated by conventional repairs or adjustment.

Normal axle noise can be described as a slight noise heard only at a certain speed or under

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unusual or remote conditions. For example, the noise tends to reach a peak at speeds from 60-100 km/h (40-60 mph) depending on road and load conditions, or on gear ratio and tire size. This slight noise is in no way indicative of trouble in the axle assembly.

Driveline noises may confuse even the best technician. Vehicle noises coming from tires, transmission, propeller shaft, universal joints, and front or rear wheel bearings are often mistaken for axle noise.

Visual/Physical Inspection

- Inspect the system for loose or missing fasteners.
- Inspect the system for leaking components.
- Inspect the system for obvious damage or conditions which may cause the symptom.

Symptom List

Refer to a system diagnostic procedure from the following list in order to diagnose the symptom:

- **Rear Drive Axle Noises**
- **Noisy in Drive**
- **Noisy When Coasting**
- **Intermittent Noise**
- **Constant Noise**
- **Noisy on Turns**

REAR DRIVE AXLE NOISES

Gear Noise

Gear noise or whine is audible from 32-89 km/h (20-55 mph) under 4 driving conditions:

- Drive- Acceleration or heavy pull
- Road Load-Vehicle driving load or constant speed
- Float-Using enough throttle to keep the vehicle from driving the engine, the vehicle slows down gradually but the engine still pulls slightly
- Coast-Throttle is closed and the vehicle is in gear

Gear noise most frequently has periods where the noise is more prominent, usually between 48-64 km/h (30-40 mph) and 80-85 km/h (50-53 mph). Gear whine is corrected by either ring and pinion gear replacement or adjustment, depending on the mileage of the gearset.

Bearing Noise

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Faulty bearings produce a rough growl or grating sound, rather than the whine typical of gear noise. Bearing noise/hum will pulsate at a constant vehicle speed. This indicates a bad pinion or a bad rear axle side bearing. This noise can be confused with rear wheel bearing noise. Inspect and replace the bearings and the affected components as required.

Rear Wheel Bearing Noise

A rough rear wheel bearing produces a noise which continues with the car coasting at low speed and the transmission in neutral. The noise may diminish some when the brakes are gently applied. The noise may also change when performing side-to-side maneuvers with the vehicle.

A rough/noisy rear wheel bearing can be heard by spinning the rear wheels by hand and listening at the hubs for the noise. Inspect and replace the bearings and the affected components as needed.

Knock at Low Speeds

A low speed knock can be caused by a differential case side gear bore that has worn oversize. Inspect the side gears and differential case and replace the components as necessary.

Backlash Clunk

Excessive backlash clunk under acceleration or deceleration can be caused by any of the following:

- Worn differential pinion shaft
- Worn differential pinion and/or side gear teeth
- Worn thrust washers
- Excessive clearance between the side gears and the axle shafts
- Excessive clearance between differential side gears and the bore in the case
- Excessive drive pinion and ring gear backlash

Inspect, adjust or replace the affected components as necessary.

NOISY IN DRIVE

Noisy in Drive

Checks	Action
Excessive pinion to ring gear backlash	Adjust the pinion to ring gear backlash. Refer to Backlash Adjustment (7.6, 8.6 Inch Axle) .
Worn pinion and ring gear	Replace the pinion and the ring gear. Refer to Drive Pinion and Ring Gear Replacement .

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Worn pinion bearings	Replace the pinion bearings. Refer to <u>Drive Pinion Bearings Replacement</u> .
Loose pinion bearings	Adjust the pinion bearings preload. Refer to <u>Pinion Depth Adjustment</u> .
Excessive pinion end play	Adjust the pinion end play. Refer to <u>Pinion Depth Adjustment</u> .
Worn differential bearings	Replace the differential bearings. Refer to <u>Differential Side Bearings Replacement</u> .
Loose differential bearings	Adjust the differential bearing preload. Refer to <u>Differential Side Bearing Preload Adjustment</u> .
Excessive ring gear runout	Replace the ring gear. Refer to <u>Drive Pinion and Ring Gear Replacement</u> .
Low oil level	Fill the fluid level to specifications with the proper lubricant. Refer to <u>Lubricant Level Inspection - Rear Drive Axle (7.6 Inch Axle)</u> <u>Lubricant Level Inspection - Rear Drive Axle (8.6 Inch Axle)</u> .
Wrong or poor grade oil	Drain and refill the system with the proper lubricant. Refer to <u>Lubricant Replacement - Rear Drive Axle</u> .
Bent axle housing	Replace the axle housing. Refer to <u>Rear Axle Housing Replacement</u> .

NOISY WHEN COASTING

Noisy When Coasting

Checks	Action
DEFINITION: Noise is audible when slowing down and disappears when driving.	
Worn pinion and ring gear	Adjust or replace the pinion and the ring gear. Refer to <u>Drive Pinion and Ring Gear Replacement</u> .
Pinion and ring gear too tight	Adjust the pinion and the ring gear backlash. Refer to <u>Backlash Adjustment (7.6, 8.6 Inch Axle)</u> .

INTERMITTENT NOISE

Intermittent Noise

Checks	Action
Warped ring gear	Replace the ring gear. Refer to <u>Drive Pinion and Ring Gear Replacement</u> .
Loose differential case bolts	Tighten differential case bolts to specifications. Refer to <u>Fastener Tightening Specifications</u> .

CONSTANT NOISE

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Constant Noise

Checks	Action
Flat spot on the pinion or the ring gear teeth	Replace the pinion and the ring gear. Refer to <u>Drive Pinion and Ring Gear Replacement</u> .
Flat spot on the pinion bearing	Replace the bearing. Refer to <u>Drive Pinion Bearings Replacement</u> .
Worn pinion splines	Replace the pinion. Refer to <u>Drive Pinion and Ring Gear Replacement</u> .
Worn axle shaft dowel holes	Replace the axle shaft. Refer to <u>Rear Axle Shaft Replacement</u> .
Worn hub studs	Replace the wheel studs. Refer to <u>Wheel Stud Replacement</u> in Rear Suspension.
Bent axle shaft	Replace the axle shaft. Refer to <u>Rear Axle Shaft Replacement</u> .

NOISY ON TURNS

Noisy on Turns

Checks	Action
Worn differential side gears and pinions	Replace the differential side gears and pinions. Refer to <u>Differential Overhaul</u> .
Worn differential spider	Replace the spine gears. Refer to <u>Differential Overhaul</u> .
Worn axle shaft splines	Replace the axle shaft. Refer to <u>Rear Axle Shaft Replacement</u> .

WHEEL BEARING WEAR - REAR DRIVE AXLE (STRAIGHT)

Straight Roller Bearing Diagnosis

Consider the following factors when diagnosing a bearing condition:

- Note the general condition of all parts during disassembly and inspection.
- Classify the failure with the aid of the illustrations.
- Determine the cause.
- Make all repairs following recommended procedures.

Wear (Minor)

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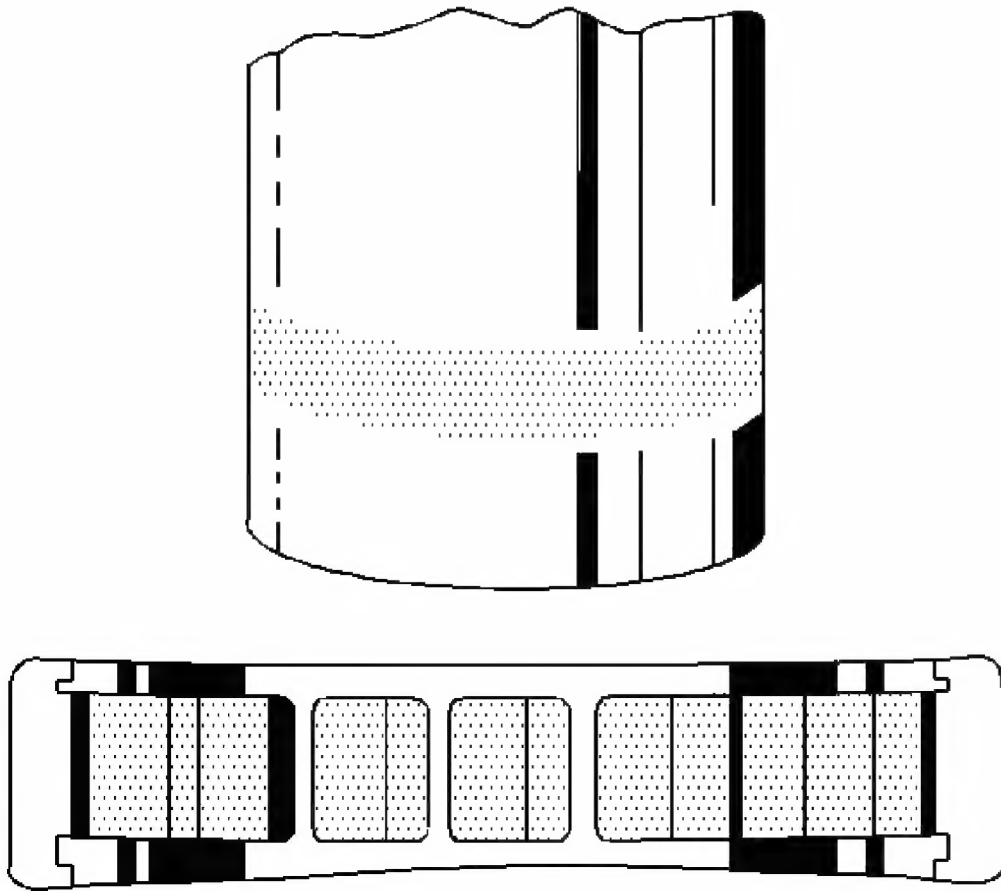


Fig. 2: Identifying Minor Wear
Courtesy of GENERAL MOTORS CORP.

Light pattern on races and rollers can be caused by fine abrasives. Clean all of the parts including the housings. Check the seals. Replace the bearings if rough or noisy. Replace the shaft if damaged.

Wear (Major)

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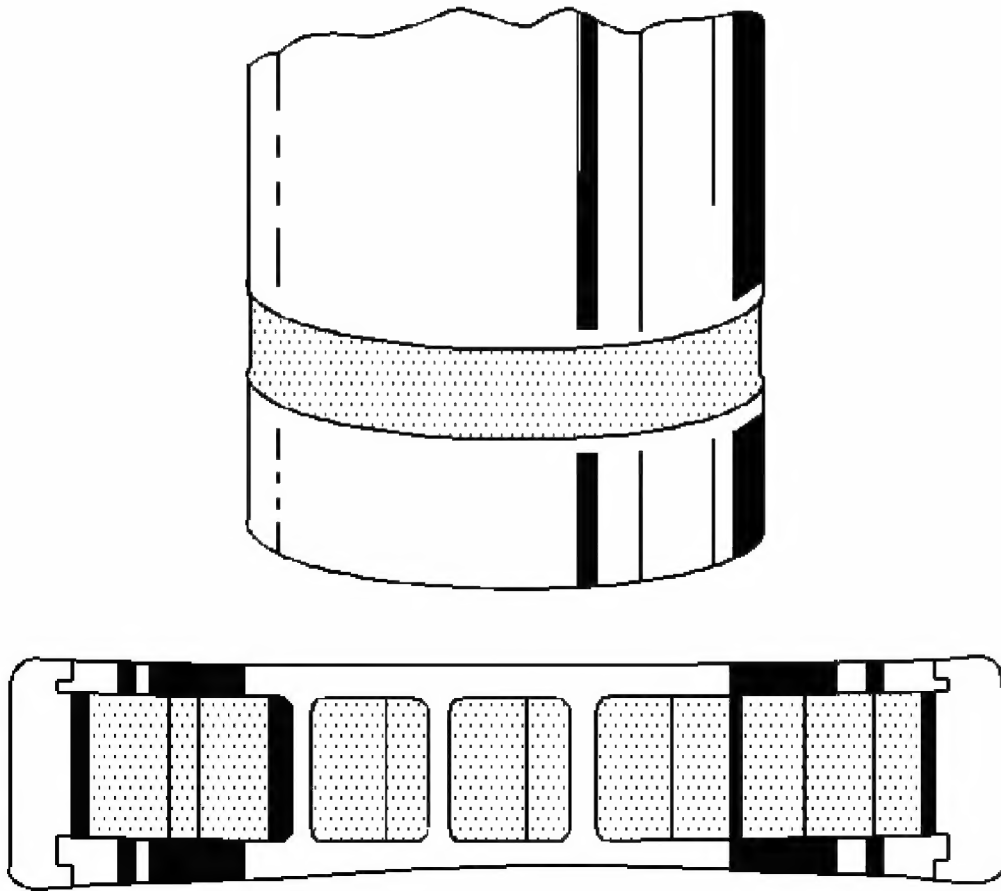


Fig. 3: Identifying Major Wear
Courtesy of GENERAL MOTORS CORP.

Heavy pattern on races and rollers can be caused by fine abrasives. Clean all of the parts including the housing. Check the seals. Replace the bearings if rough or noisy. Replace the shaft if damaged.

Brinelling

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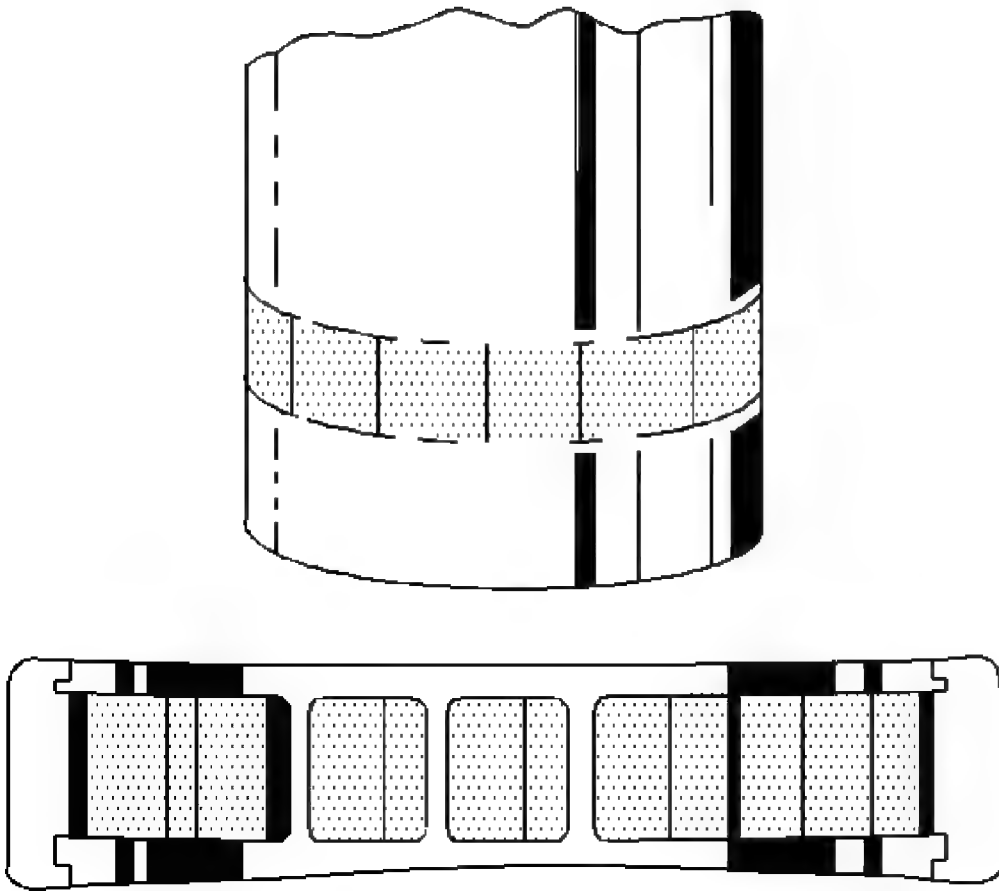


Fig. 4: Identifying Brinelling
Courtesy of GENERAL MOTORS CORP.

Surface indentations in the raceway can be caused by roll either under impact loading or vibration while the bearing is not rotating. Replace the bearing if rough or noisy. Replace the shaft if damaged.

Indentations

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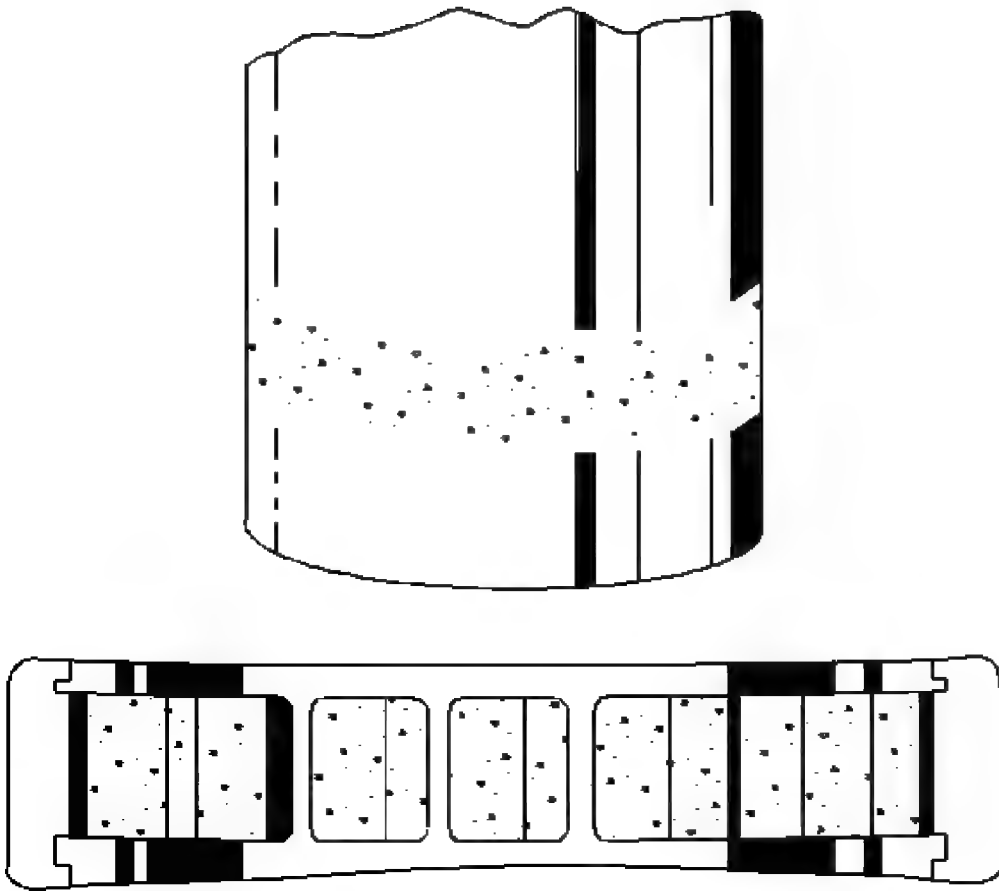


Fig. 5: Identifying Indentations

Courtesy of GENERAL MOTORS CORP.

Surface depressions on race and rollers can be caused by hard particles of foreign material. Clean all of the parts, including the housing. Check the seals. Replace the bearings if rough or noisy. Replace the shaft if damaged.

Single Edge Pitting

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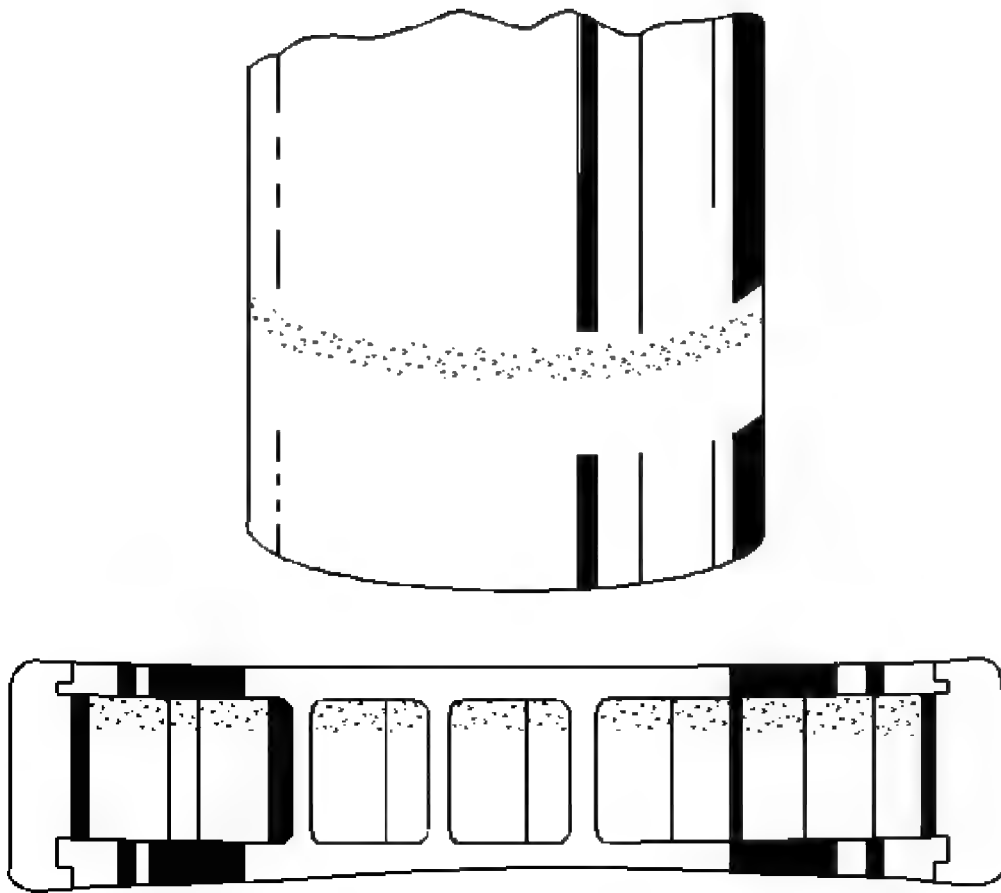


Fig. 6: Identifying Single Edge Pitting
Courtesy of GENERAL MOTORS CORP.

Flaking of surface metal results from fatigue, usually at one edge of race and rollers. Replace the bearing. Clean all related parts. Replace the shaft if damaged.

Double Edge Pitting

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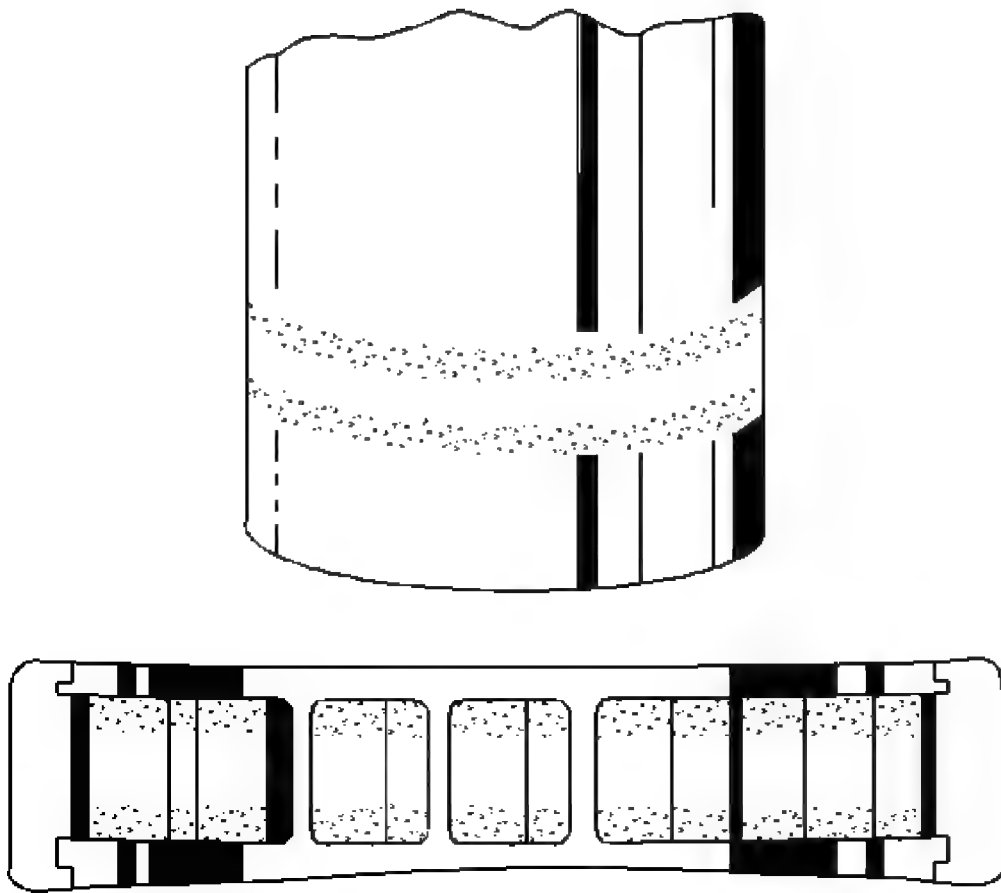


Fig. 7: Identifying Double Edge Pitting
Courtesy of GENERAL MOTORS CORP.

Flaking of surface metal results from fatigue, usually at both edges of the race and rollers. Replace the bearing. Clean all related parts. Replace the shaft if damaged.

Misalignment

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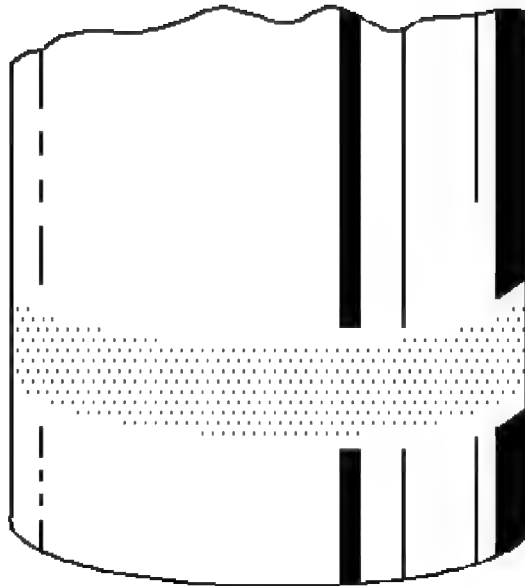


Fig. 8: Identifying Misalignment
Courtesy of GENERAL MOTORS CORP.

Outer misalignment due to a foreign object. Replace the bearing. Ensure races are properly seated. Replace the shaft if the bearing operating surface is damaged.

Fretting

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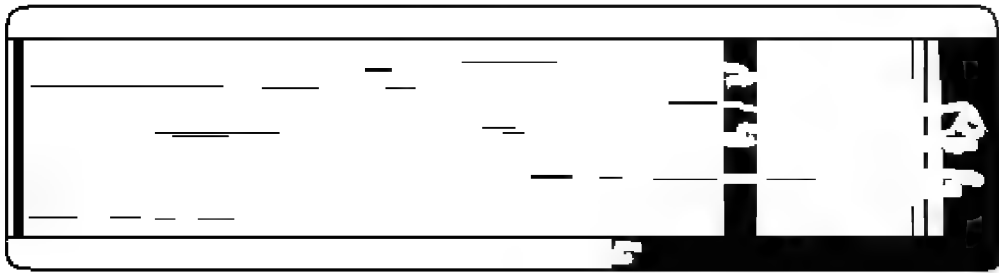
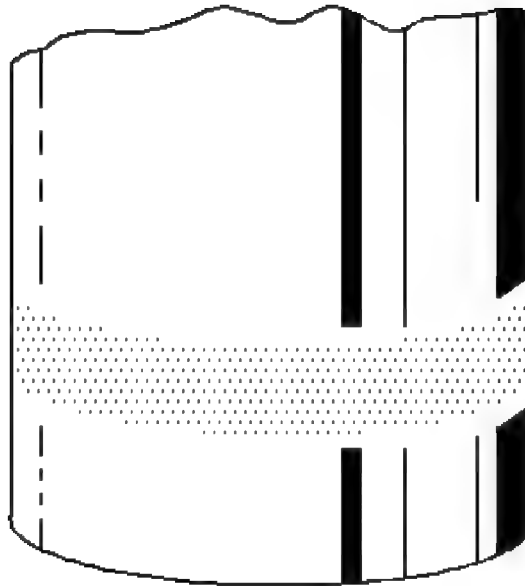


Fig. 9: Identifying Frettage
Courtesy of GENERAL MOTORS CORP.

Corrosion set up by a small relative movement of parts with no lubrication. Replace the bearing. Clean all the relative parts. Check the seals. Check for proper fit and lubrication. Replace the shaft if damaged.

Smears

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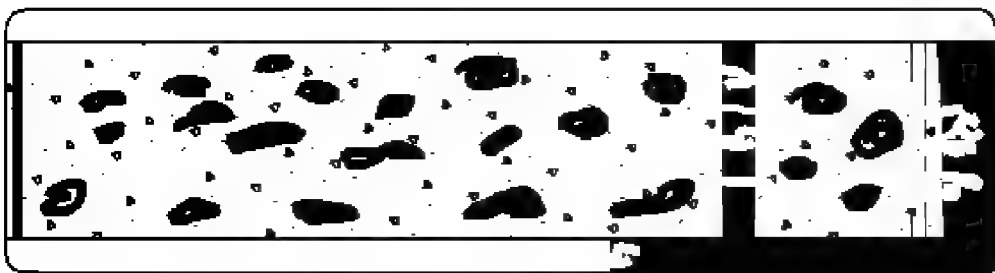
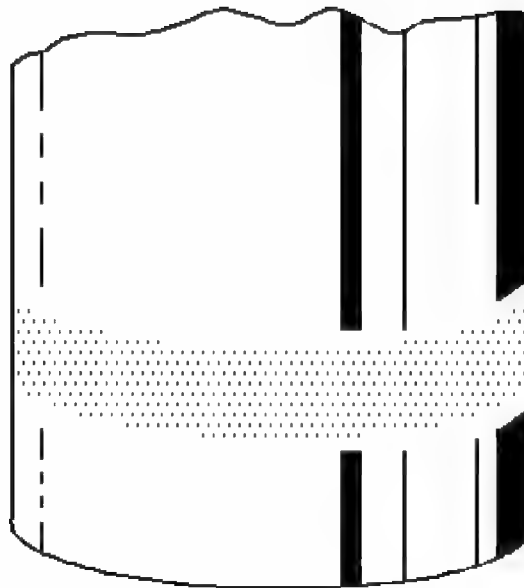


Fig. 10: Identifying Smears

Courtesy of GENERAL MOTORS CORP.

Smearing of metal due to slippage. Slippage can be caused by poor fits, lack of lubrication, overheating, overloads or handling damage. Replace the bearing. Clean all the related parts. Check for proper fit and lubrication.

WHEEL BEARING WEAR - REAR DRIVE AXLE (TAPERED)

Tapered Roller Bearing Diagnosis

Consider the following factors when diagnosing bearing condition:

- General condition of all parts during disassembly and inspection
- Classify the failure with the aid of the illustrations.

- Determine the cause.
- Make all repairs following recommended procedures.

Abrasive Roller Wear

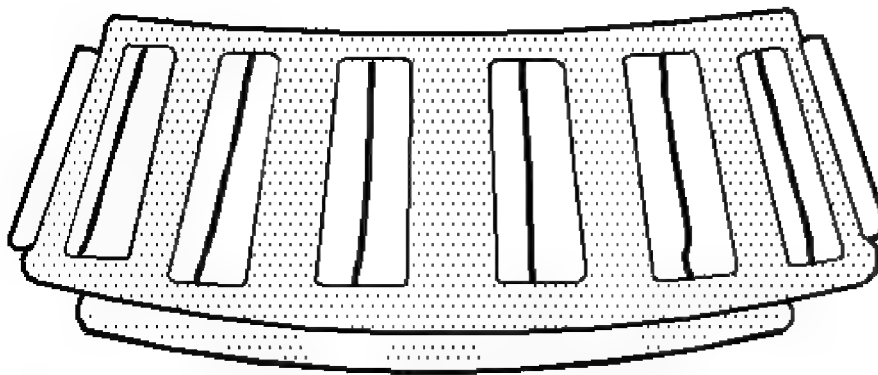
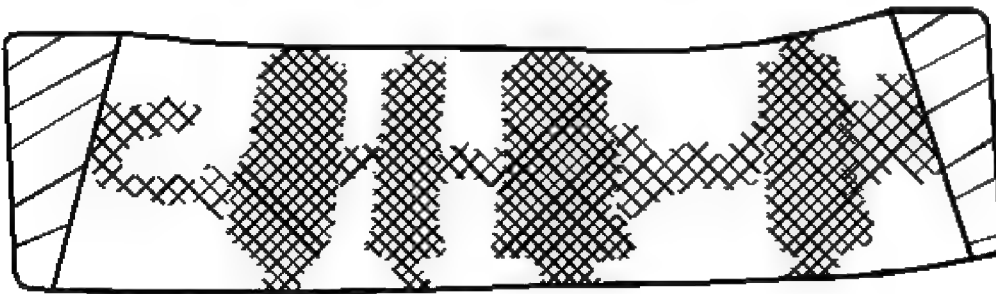


Fig. 11: Identifying Abrasive Roller Wear
Courtesy of GENERAL MOTORS CORP.

Pattern on the races and the rollers caused by fine abrasives. Clean all of the parts and the housings. Check the seals and the bearings. Replace any leaky, rough, or noisy bearings.

Abrasive Step Wear

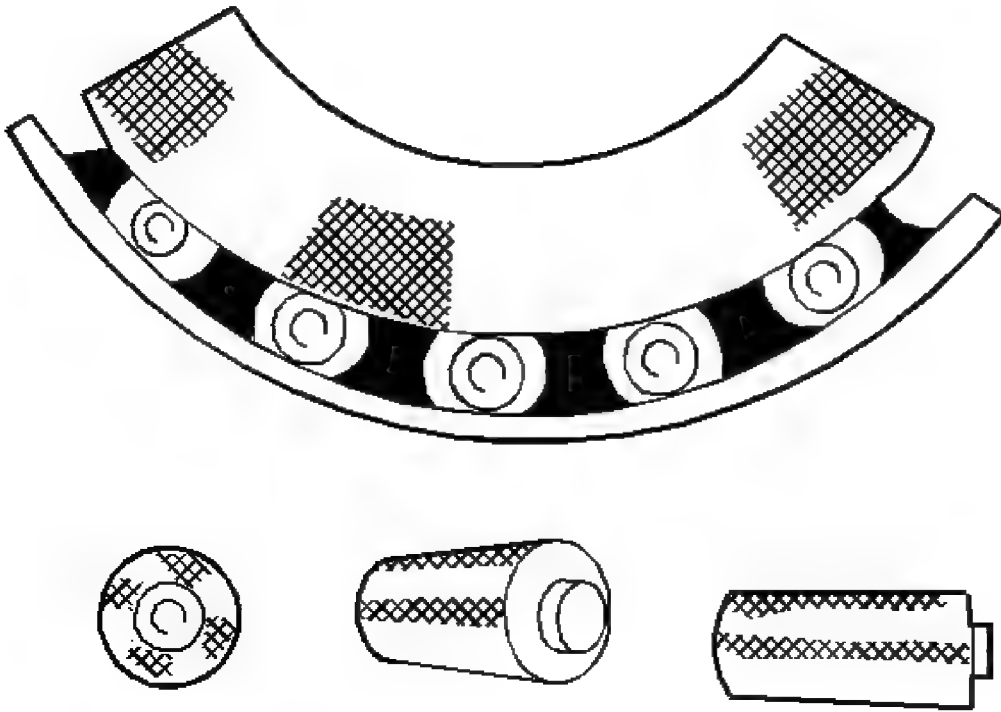


Fig. 12: Identifying Abrasive Step Wear
Courtesy of GENERAL MOTORS CORP.

Pattern on the roller ends caused by fine abrasives. Clean all of the parts and the housings. Check the seals and the bearings. Replace any leaky, rough, or noisy bearings.

Galling

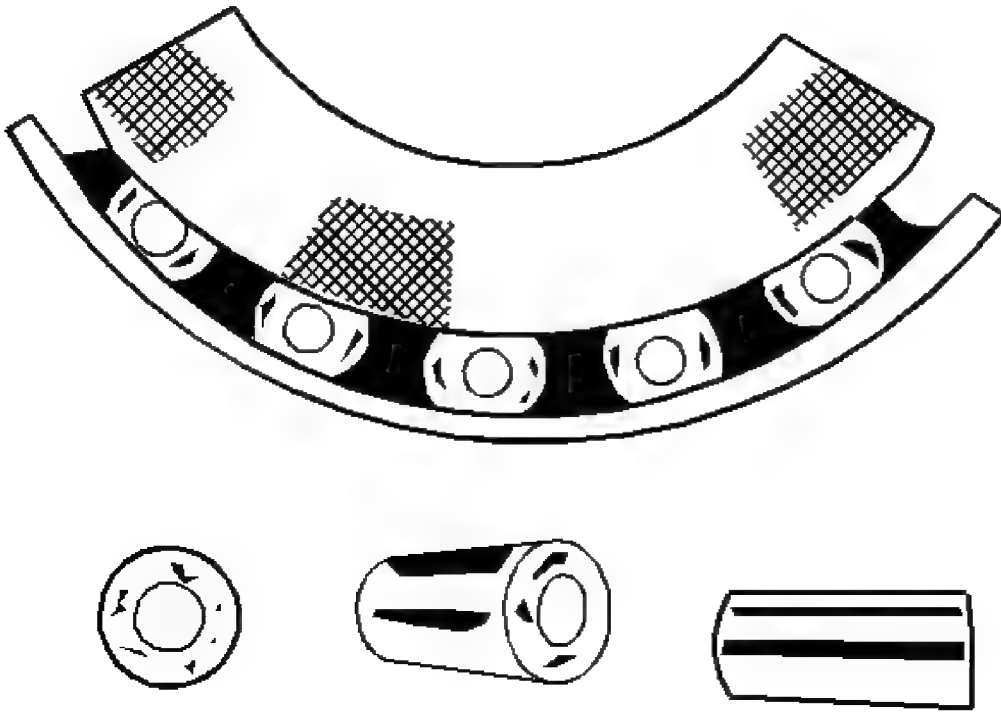


Fig. 13: Identifying Galling
Courtesy of GENERAL MOTORS CORP.

Metal smears on the roller ends due to overheating, lubricant failure, or lubricant overload. Replace the bearing. Check the seals. Check for proper lubrication.

Etching

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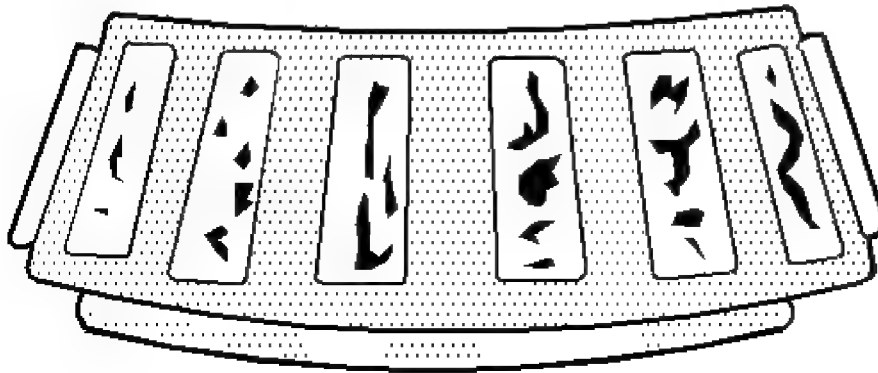
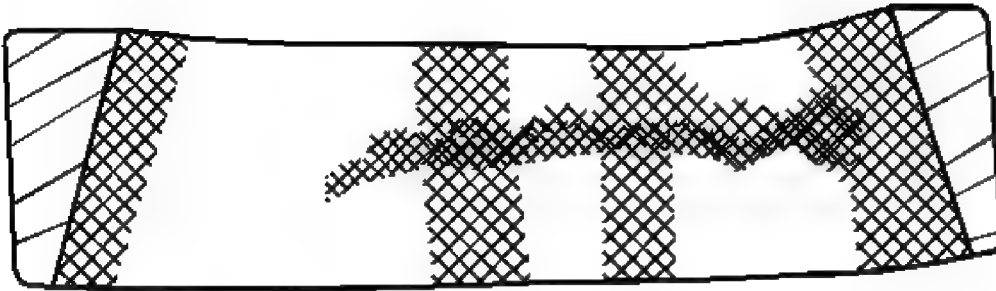


Fig. 14: Identifying Etching
Courtesy of GENERAL MOTORS CORP.

Bearing surfaces appear gray or grayish black in color, with related etching away of material usually at roller spacing. Replace the bearings. Check the seals. Check for proper lubrication.

Bent Cage

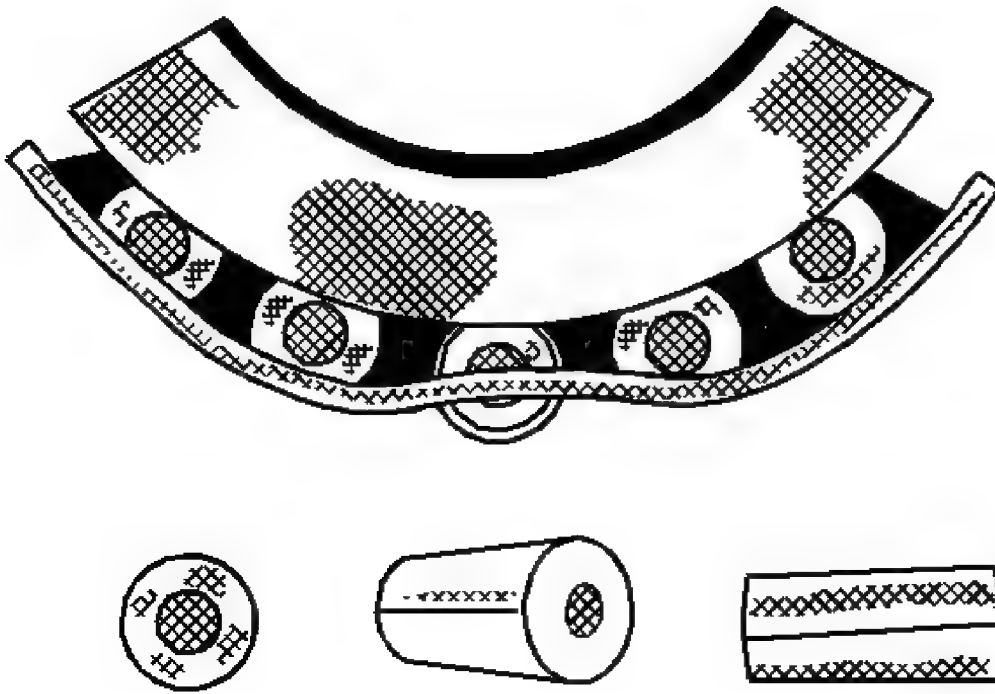


Fig. 15: Identifying Bent Roller Cage
Courtesy of GENERAL MOTORS CORP.

A damaged cage due to improper handling or improper tool usage. Replace the bearing.

Cage Wear

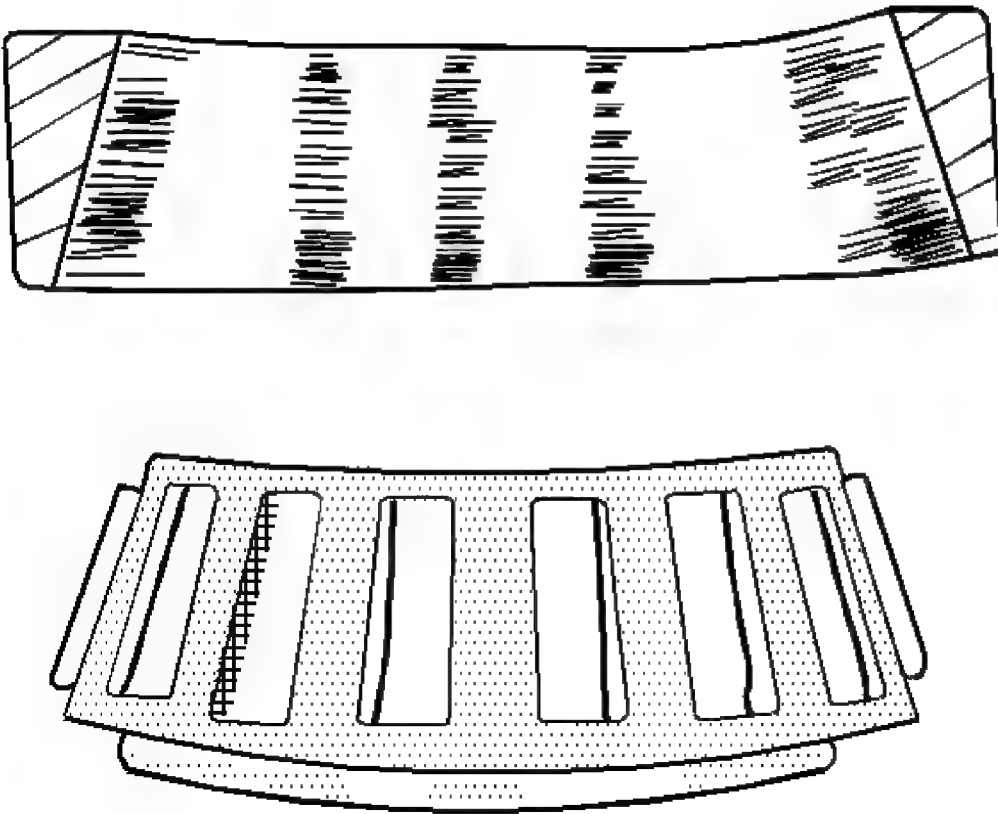


Fig. 16: Identifying Cage Wear
Courtesy of GENERAL MOTORS CORP.

Wear around the outside diameter of the cage and the roller pockets caused by abrasive material. Wear caused from inefficient lubrication. Clean the related parts and the housings. Check the seals. Replace the bearings.

Indentations

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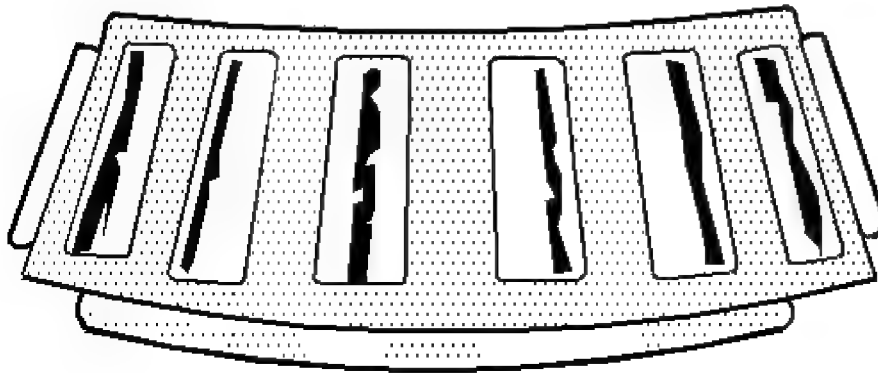
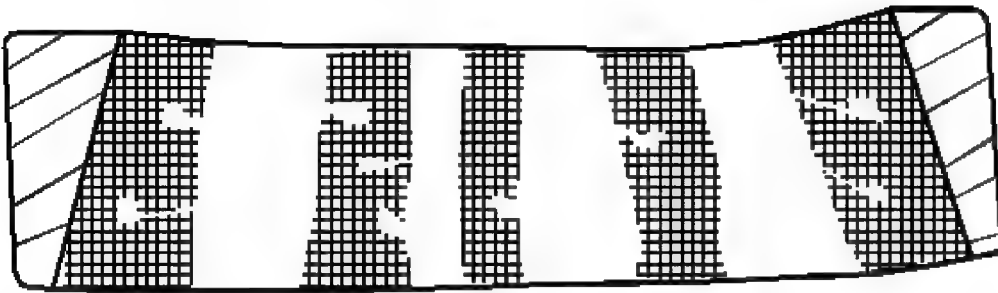


Fig. 17: Inspecting Bearing Rollers & Races For Heat Discoloration
Courtesy of GENERAL MOTORS CORP.

Surface depressions on the race and the rollers caused by hard particles of foreign matter. Clean all the parts and the housings. Check the seals. Replace rough or noisy bearings.

Fretting

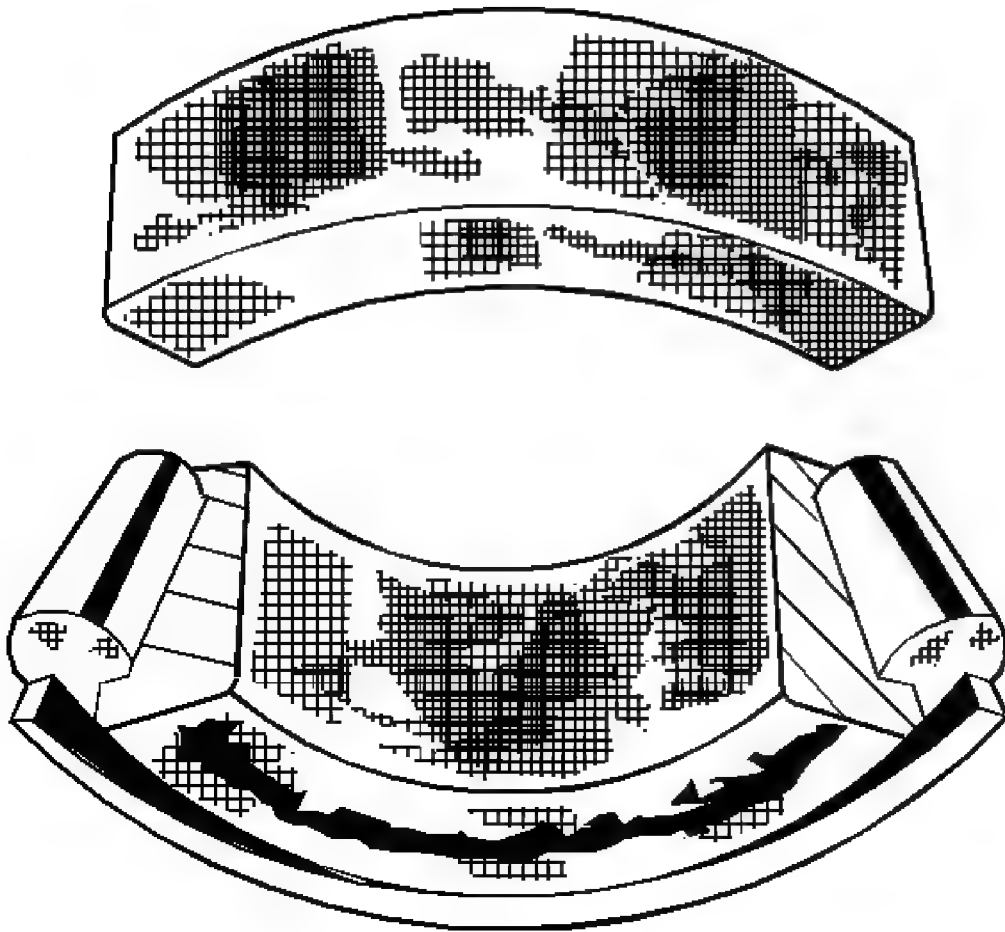


Fig. 18: Identifying Fretting
Courtesy of GENERAL MOTORS CORP.

Corrosion caused by small relative movement of parts with no lubrication. Replace the bearing. Clean the related parts. Check the seals. Check for proper lubrication.

Smears

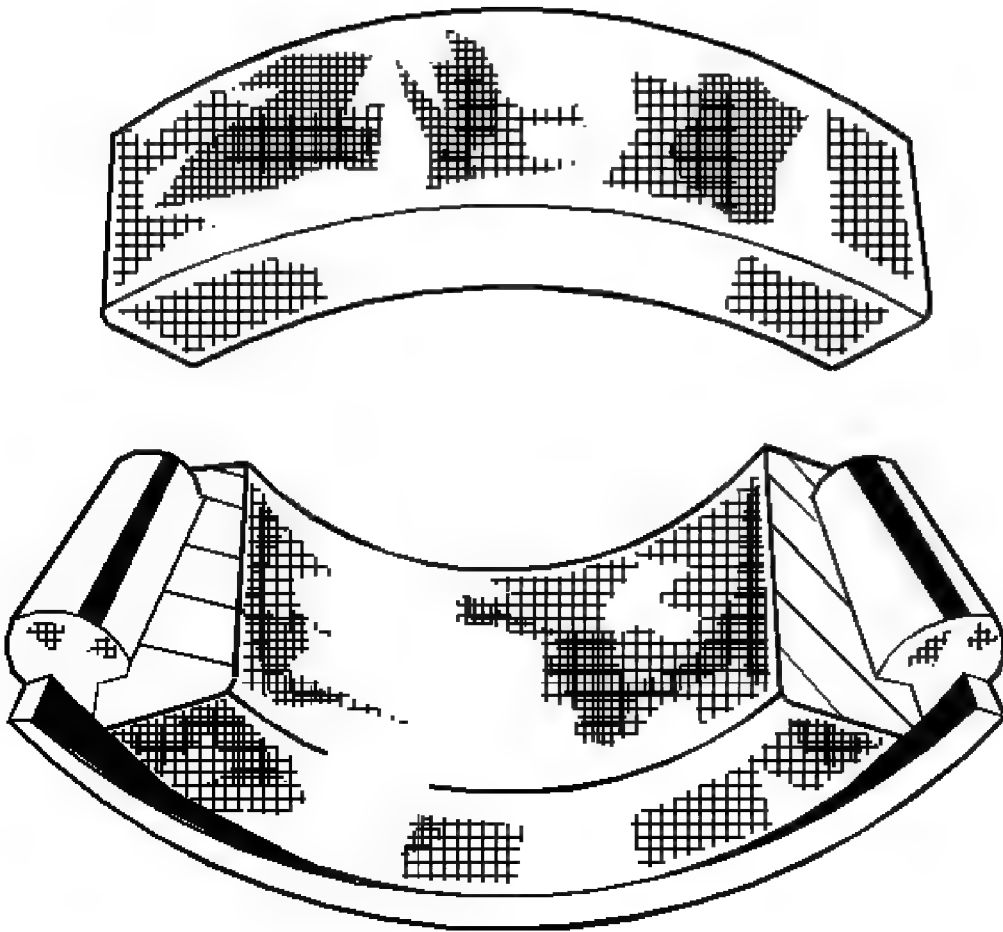


Fig. 19: Identifying Smears

Courtesy of GENERAL MOTORS CORP.

Smearing of the metal due to slippage. Slippage can be caused by the following factors:

- Poor fits
- Lubrication
- Overheating
- Overloads
- Handling damage

Replace the bearings. Clean the related parts. Check for proper fit and lubrication.

Stain Discoloration

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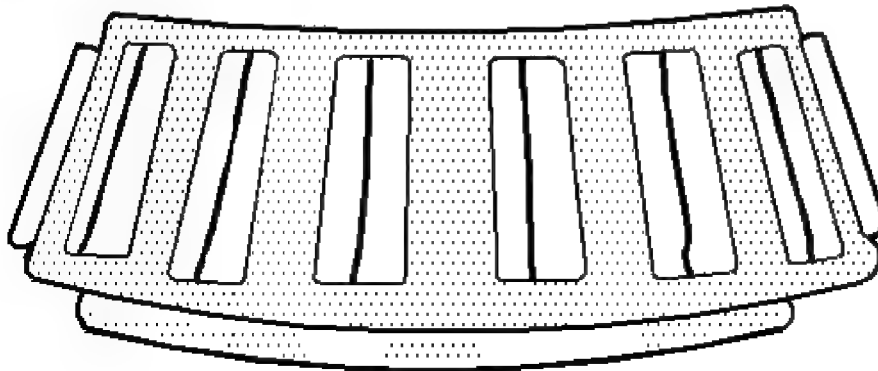
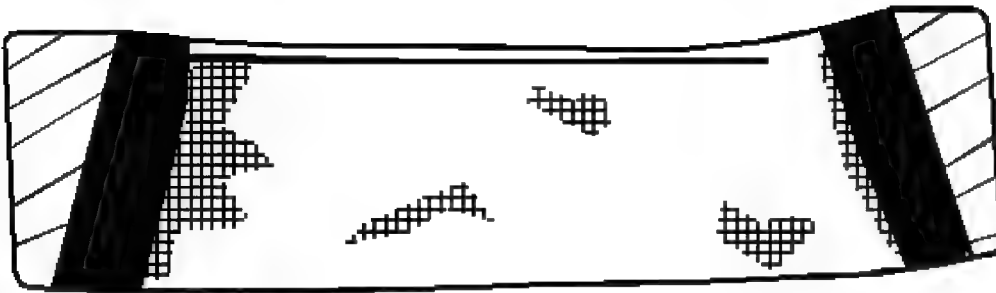


Fig. 20: Identifying Stain Discoloration
Courtesy of GENERAL MOTORS CORP.

Discoloration ranging from light brown to black. This discoloration is caused from incorrect lubrication or moisture. Reuse the bearing if you can remove the stains with light polishing. Reuse the bearing if there is no evidence of overheating. Check the seals and the related parts for damage.

Heat Discoloration

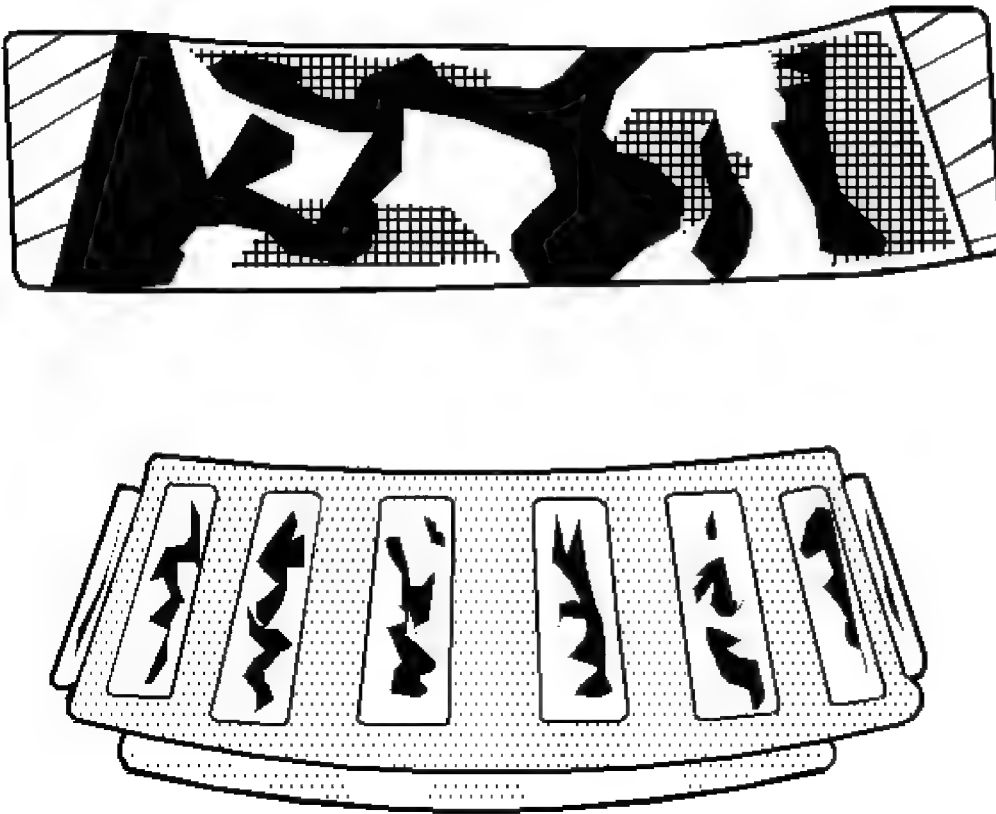


Fig. 21: Identifying Heat Discoloration
Courtesy of GENERAL MOTORS CORP.

Heat discoloration ranges from faint yellow to dark blue. This discoloration results from overload or an incorrect lubricant. Excessive heat causes softening of the races or the rollers. In order to check for loss of temper on the races and the rollers, perform a file test. A file drawn over a tempered part will grab and cut the metal. A file drawn over a hard part will glide readily with no metal cutting. Replace the bearings if overheating damage is indicated. The tempered part will fail the file test. Check the seals and the other related parts.

Misalignment

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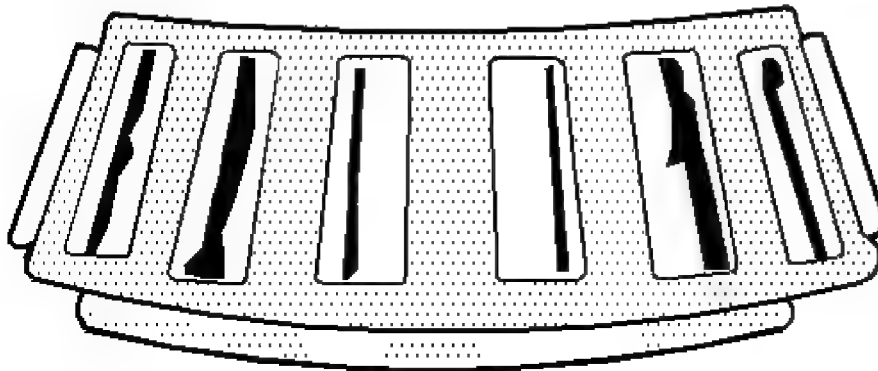
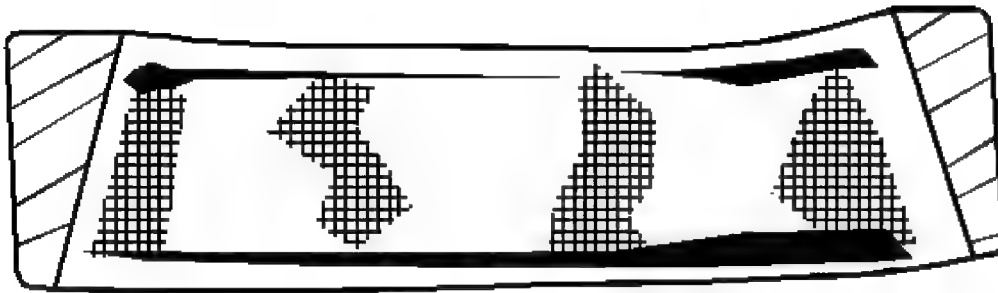


Fig. 22: Identifying Misalignment
Courtesy of GENERAL MOTORS CORP.

A misaligned outer race due to a foreign object. Clean the related parts. Replace the bearing. Ensure the races are properly sealed.

Cracked Inner Race

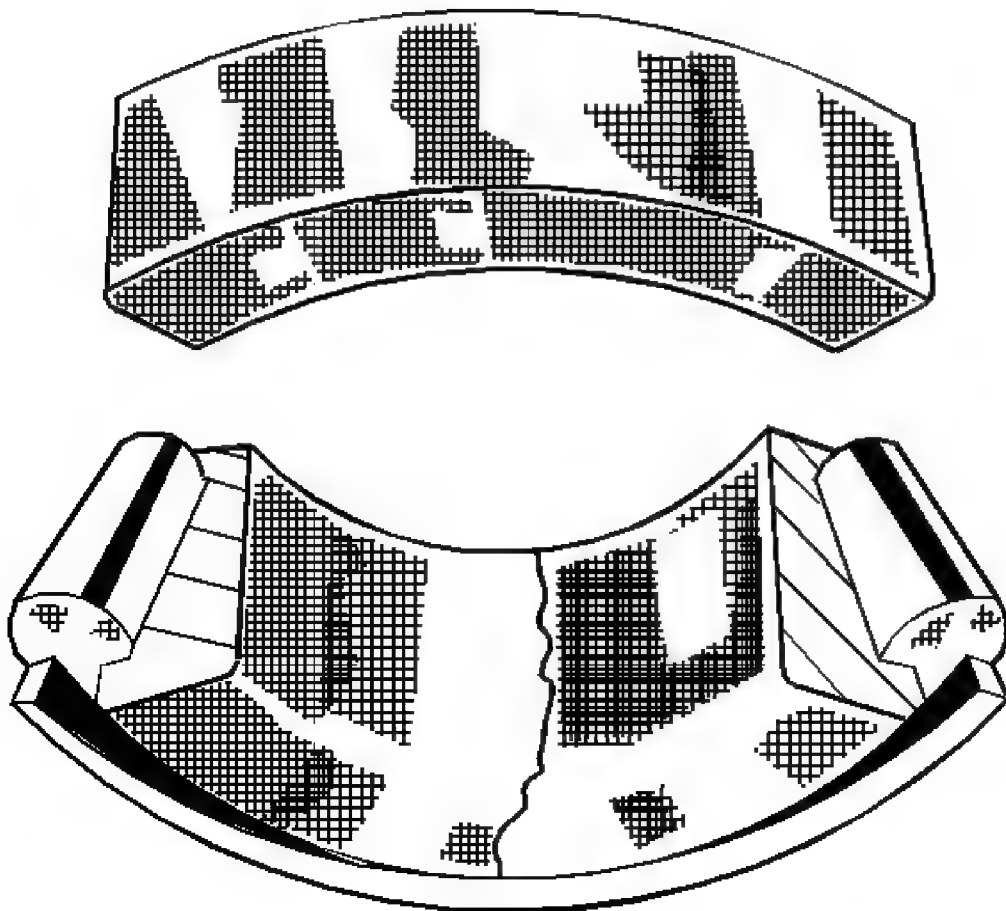


Fig. 23: Identifying Cracked Inner Race
Courtesy of GENERAL MOTORS CORP.

Cracked race due to improper fit, cocking, or poor bearing seats. Replace the bearing.
Correct bearing seats.

Fatigue Spalling

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2004 DRIVELINE/AXLES Rear Drive Axle - Blazer/S10, Jimmy/Sonoma

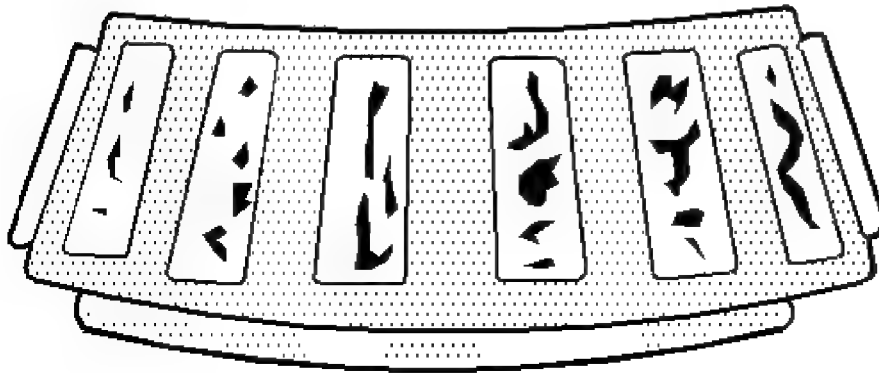


Fig. 24: Inspecting Bearing Rollers & Races For Pitting, Grooves, Spalling & Excessive Wear

Courtesy of GENERAL MOTORS CORP.

Flaked surface metal that results from fatigue. Replace the bearing. Clean all related parts.

Brinelling

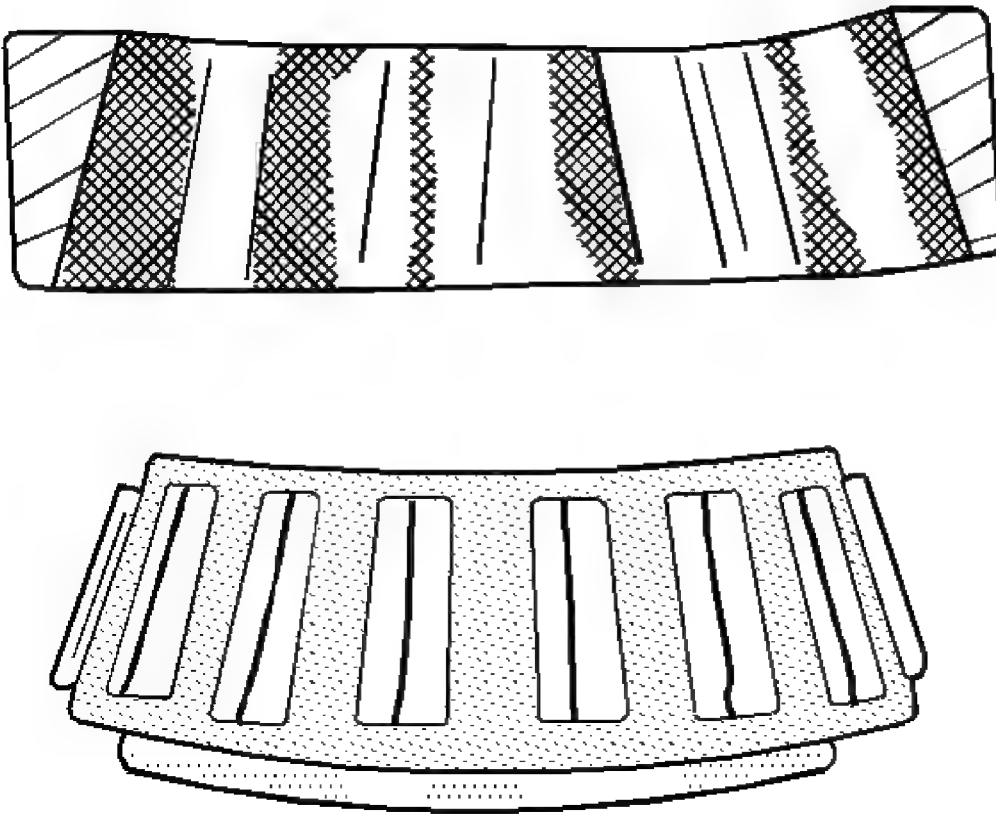


Fig. 25: Identifying Brinelling
Courtesy of GENERAL MOTORS CORP.

Surface indentations in the race way caused by the rollers under impact loading or caused from vibration while the bearing is not rotating. Replace a rough or noisy bearing.

REAR AXLE LUBRICANT LEAK DIAGNOSIS

Rear axle lubricant leaks can occur at the following locations:

- Axle tube to differential carrier housing joint
- Axle shaft oil seal
- Axle housing porosity
- Differential housing cover gasket
- Drain plug
- Fill plug
- Pinion yoke oil seal

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- Vent tube

Determining the Cause

While most rear axle leaks may be easy to find, determining the cause may not be. A thorough inspection of the area around the leak may assist in determining the cause of the leak.

Oil Seals

Lubricant leaks from a oil seal may be caused by any of the following:

- An improperly installed seal
- A distorted seal
- A worn seal
- A worn shaft
- A brittle seal lip
- A hardened seal lip

To determine the actual cause of the leak, clean the area around the leak. Observe the area of the leak and determine if the seal or another component is causing the leak. A worn seal surface will cause a leak at the sealing lip while a misaligned seal or a seal installed into a housing with an excessive bore will cause the seal to leak at the outside surface of the seal. Hardened or cracked seal lips usually indicate the axle is operating beyond the normal temperature limits for the axle. A seal whose sealing surface has been nicked or cut may indicate that the shaft has a rough, burred, or gouged surface and will need to be inspected before the seal can be replaced.

Gaskets

A leak at a gasket is usually caused by a poor fit of the components on each side of the gasket surface. Inspect each component for distortion and for nicks or gouges that may prohibit the gasket from sealing properly.

Rear Axle Housing

Rear axle housing lubricant leaks usually occur at the following locations:

- Drain Plug
- Fill Plug

Drain and fill plug leaks are usually caused by a loose plug. These leaks can be repaired by either tightening the plug or by using an approved sealer on the threads on the plug.

Other leaks such as axle tube to differential carrier housing or porosity leaks require the

replacement of the rear axle housing.

REPAIR INSTRUCTIONS

LUBRICANT LEVEL INSPECTION - REAR DRIVE AXLE (7.6 INCH AXLE)

1. Raise the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
2. Make sure the vehicle is level.
3. Inspect the rear axle for leaks. Repair as necessary.
4. Clean the area around the rear axle fill plug.

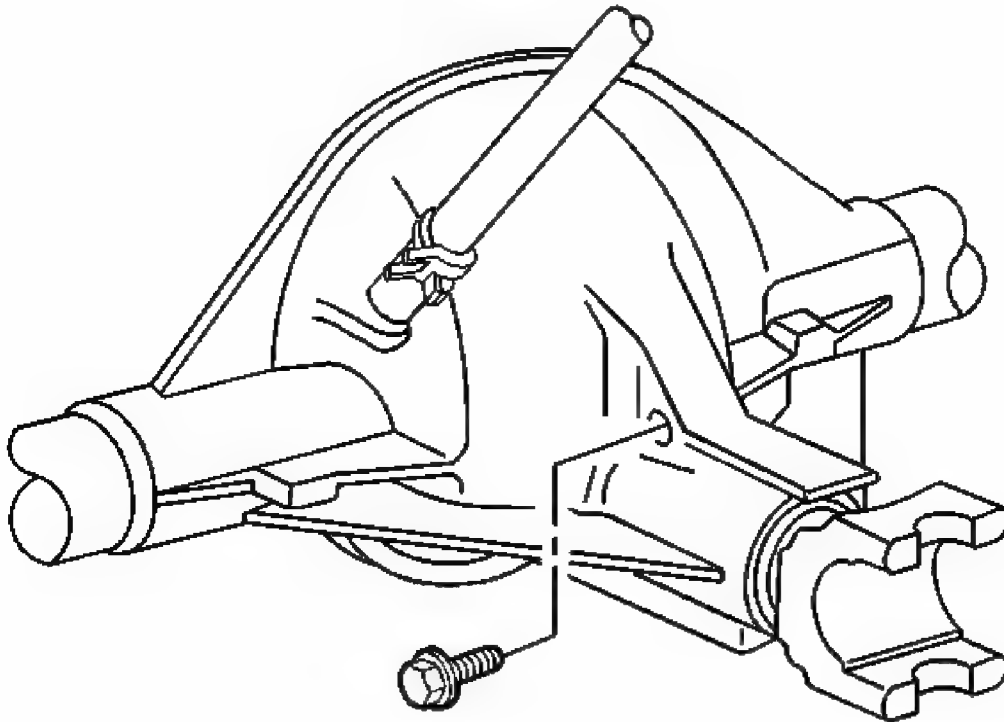


Fig. 26: Locating Rear Axle Fill Plug
Courtesy of GENERAL MOTORS CORP.

5. Remove the rear axle fill plug.
6. Inspect the lubricant level.

Specification: The lubricant level should be between 0-10 mm (0-0.4 in) below the fill plug opening.

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7. If the level is low, add lubricant until the level is even with the bottom edge of the fill plug opening. Use the proper fluid. Refer to **Fluid and Lubricant Recommendations** in Maintenance and Lubrication.

NOTE: Refer to **Fastener Notice** in Cautions and Notices.

8. Install the rear axle fill plug.

Tighten: Tighten the rear axle fill plug to 33 N.m (24 lb ft).

9. Lower the vehicle.

LUBRICANT LEVEL INSPECTION - REAR DRIVE AXLE (8.6 INCH AXLE)

1. Raise the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
2. Make sure the vehicle is level.
3. Inspect the rear axle for leaks. Repair as necessary.
4. Clean the area around the rear axle fill plug.

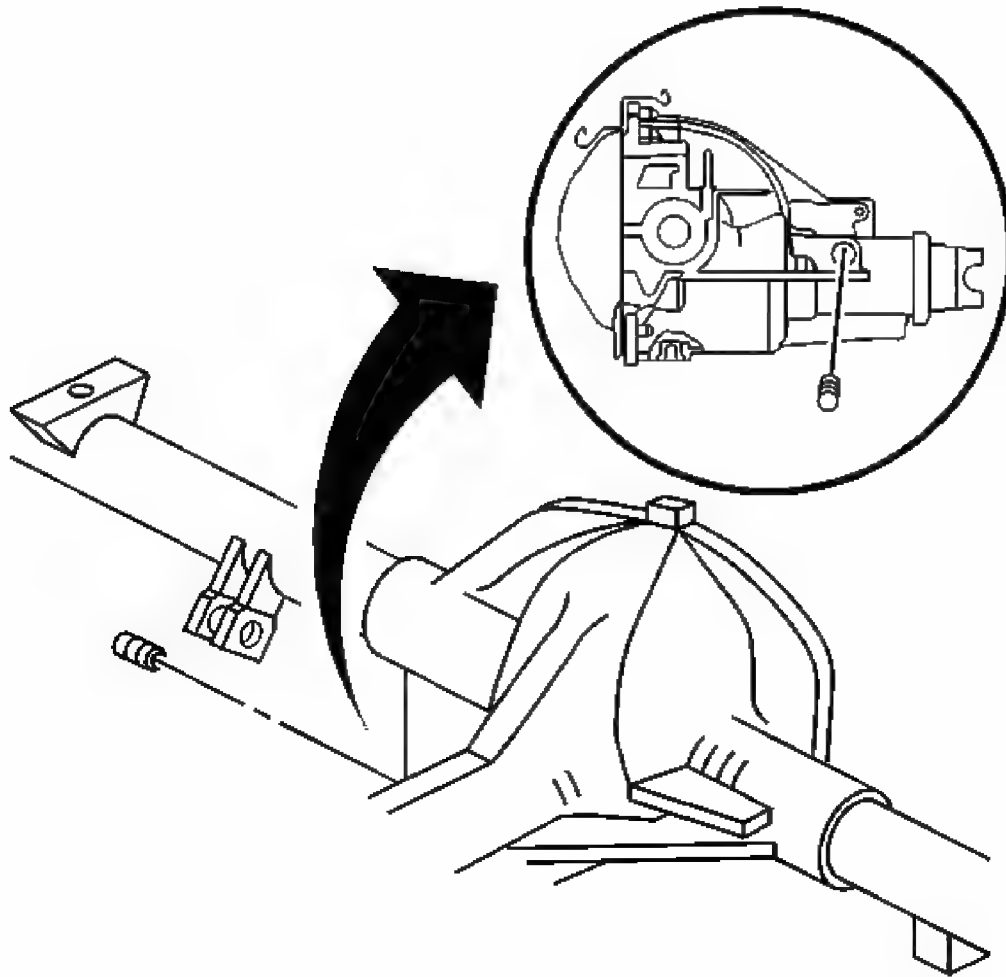


Fig. 27: Locating Rear Axle Fill Plug
Courtesy of GENERAL MOTORS CORP.

5. Remove the rear axle fill plug.
6. Fabricate a dipstick from a pipe cleaner or similar item. Form the pipe cleaner into an "L".
7. Insert the pipe cleaner into the fill plug opening with the stem facing down.
8. Remove the pipe cleaner and measure the distance from the bend in the pipe cleaner to the lubricant level.

Specification: The distance between the bend and the lubricant level should be 15-40 mm (0.6-1.6 in).

9. If the measurement is greater than 40 mm (1.6 in), add lubricant until the level is

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between 15-40 mm (0.6-1.6 in) from the bottom edge of the fill plug hole. Use the proper fluid. Refer to **Fluid and Lubricant Recommendations** in Maintenance and Lubrication.

NOTE: Refer to **Fastener Notice** in Cautions and Notices.

10. Install the rear axle fill plug.

Tighten: Tighten the rear axle fill plug to 33 N.m (24 lb ft).

11. Lower the vehicle.

LUBRICANT REPLACEMENT - REAR DRIVE AXLE

Removal Procedure

1. Raise the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.

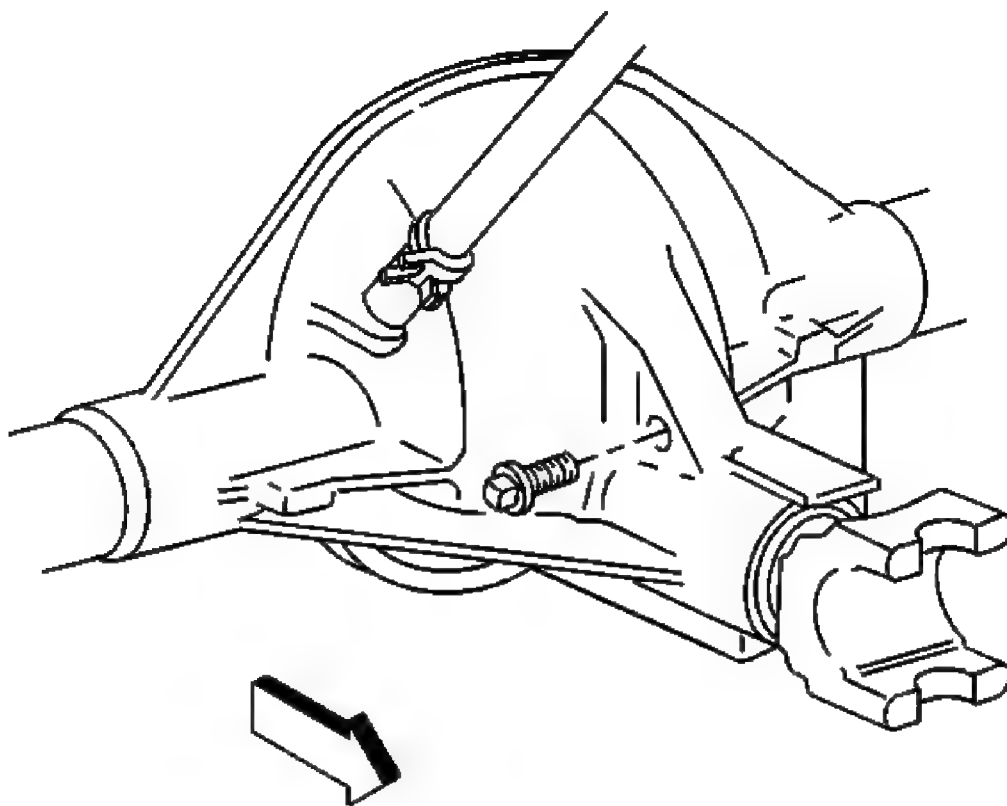


Fig. 28: View Of Rear Axle Fill Plug
Courtesy of GENERAL MOTORS CORP.

2. Remove the rear axle fill plug.

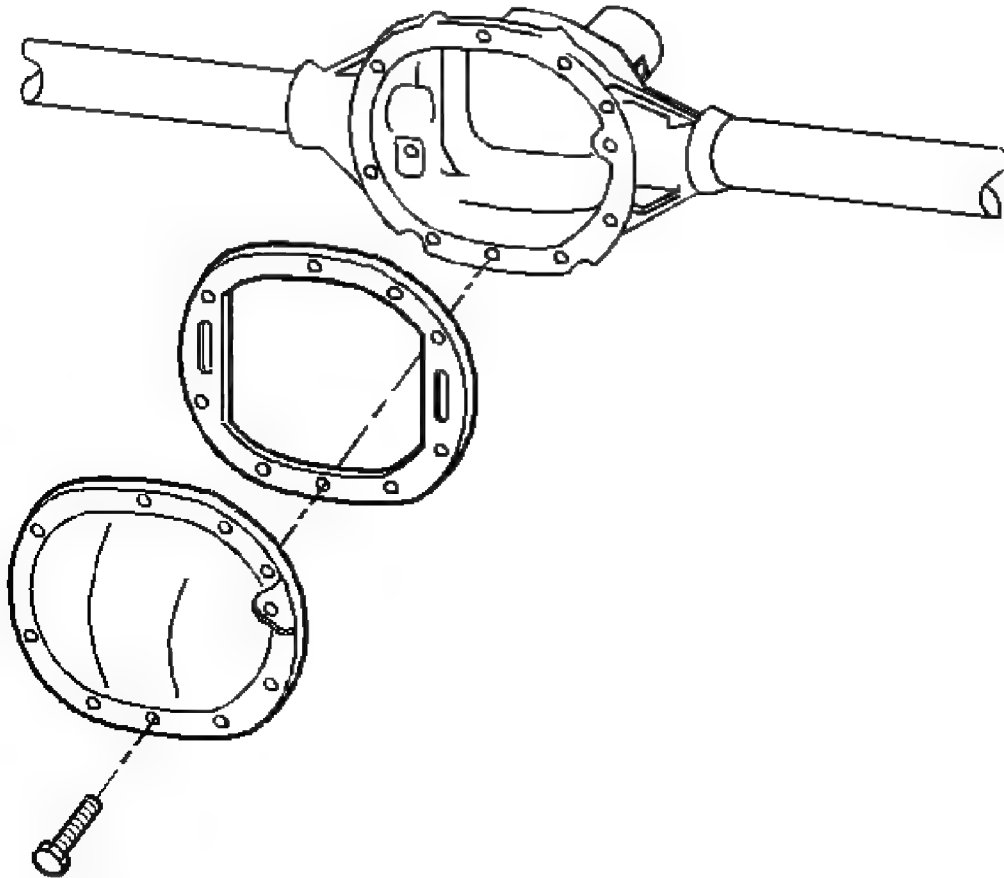


Fig. 29: View Of Rear Axle Housing Cover & Rear Axle Housing Cover Gasket
Courtesy of GENERAL MOTORS CORP.

3. Remove the rear axle housing cover and the rear axle housing cover gasket.
4. Drain the lubricant into a suitable container.
5. Inspect the bottom of the rear axle housing for excessive metal particle accumulation. This accumulation is symptomatic of extreme wear.

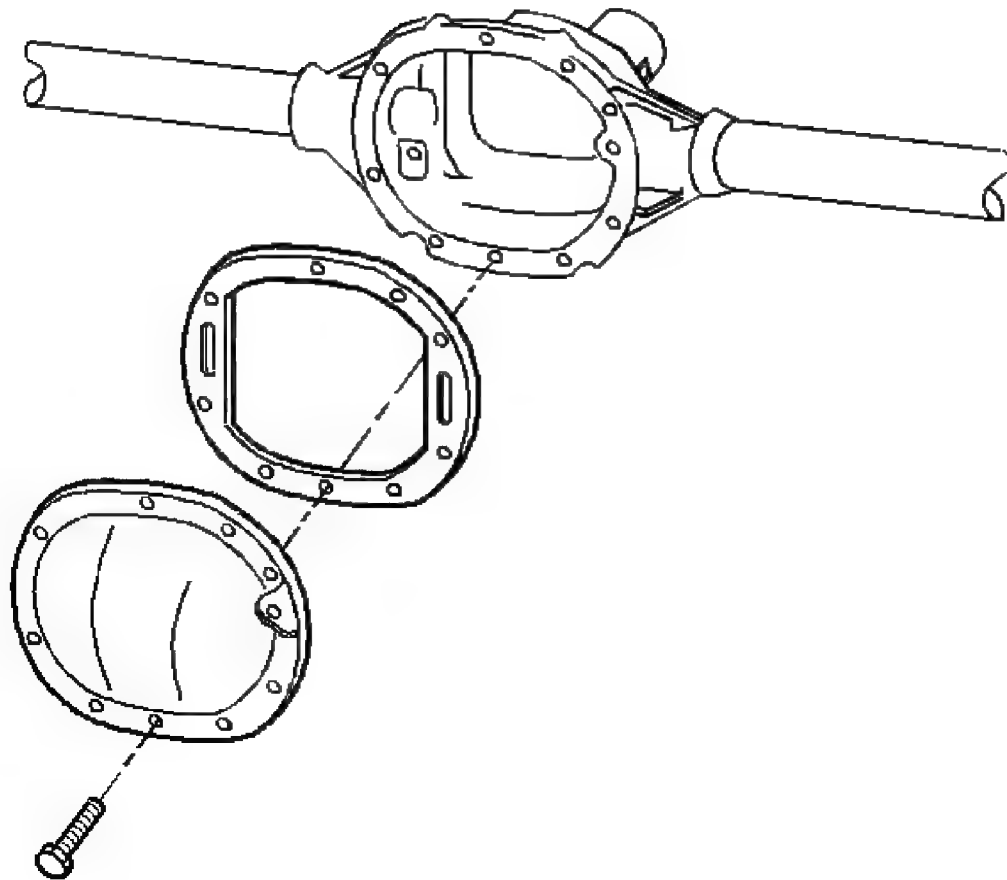


Fig. 30: View Of Rear Axle Housing Cover & Rear Axle Housing Cover Gasket
Courtesy of GENERAL MOTORS CORP.

1. Install the new rear axle housing cover gasket and the rear axle housing cover.

NOTE: Refer to Fastener Notice in Cautions and Notices.

2. Install the rear axle housing cover bolts.

Tighten: Tighten the rear axle housing cover bolts in a crosswise pattern to 39 N.m (29 lb ft).

3. Fill the rear axle. Use the proper fluid. Refer to Capacities - Approximate Fluid and Fluid and Lubricant Recommendations in Maintenance and Lubrication.

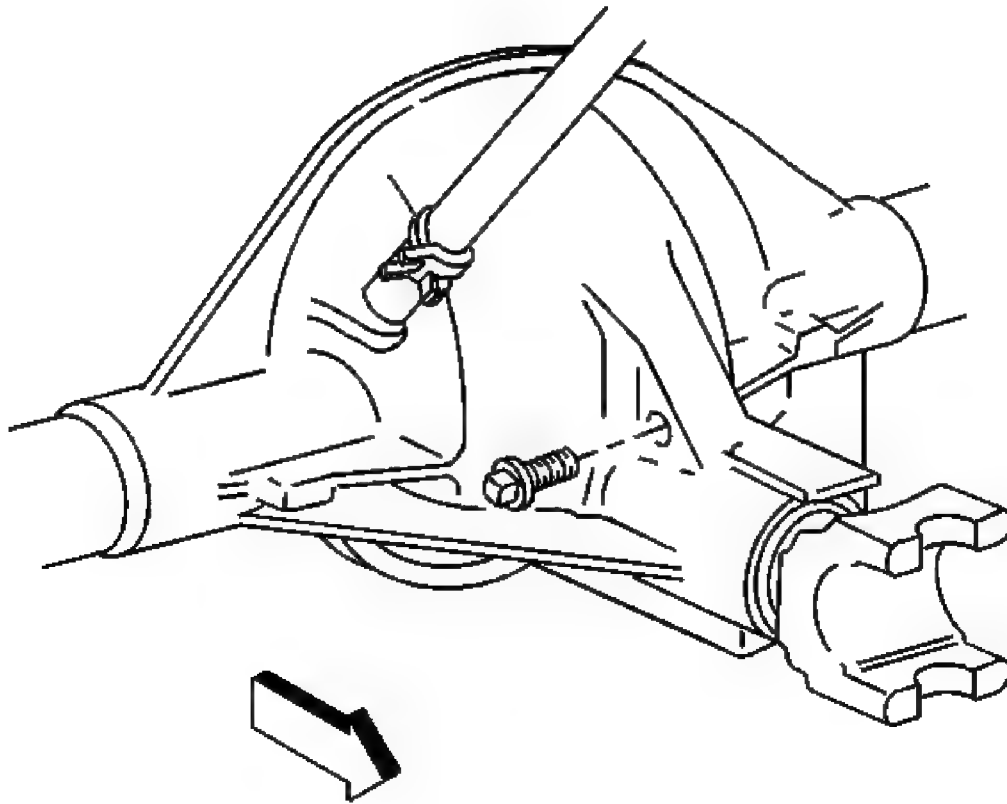


Fig. 31: View Of Rear Axle Fill Plug
Courtesy of GENERAL MOTORS CORP.

4. Install the rear axle fill plug.

Tighten: Tighten the rear axle fill plug to 33 N.m (24 lb ft).

5. Lower the vehicle.

VENT HOSE REPLACEMENT

Removal Procedure

The axle vent assembly is on the right side of the axle carrier.

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.

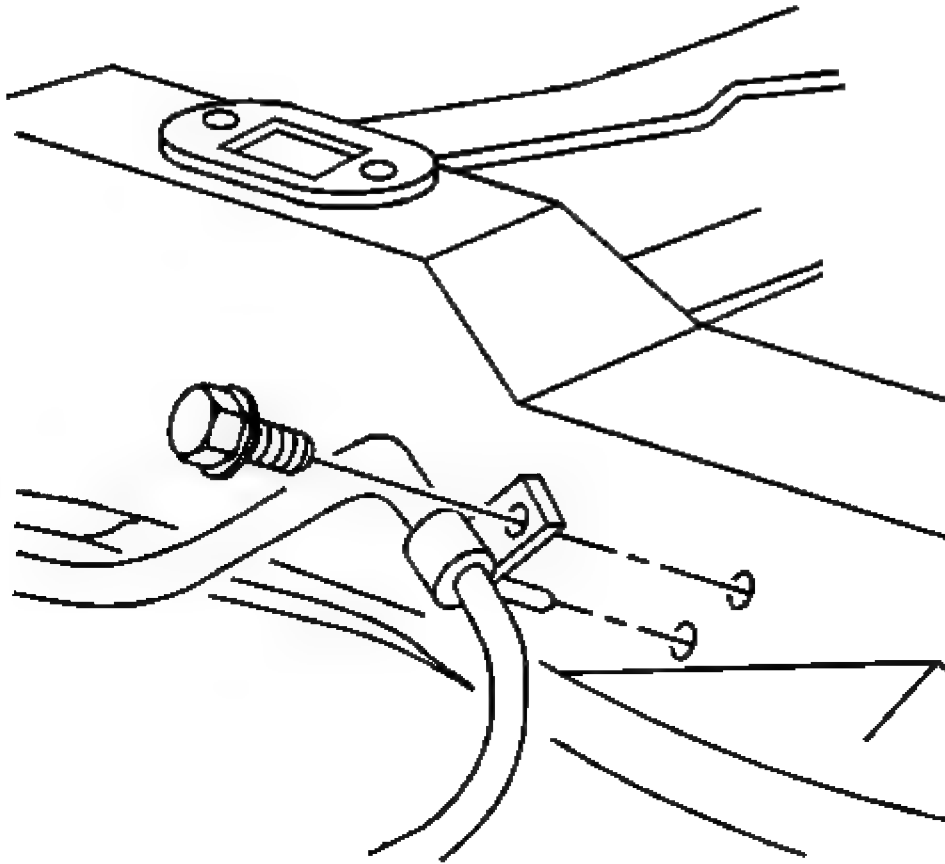


Fig. 32: View Of Vent Clamp Bolt
Courtesy of GENERAL MOTORS CORP.

2. Remove the vent clamp bolt.

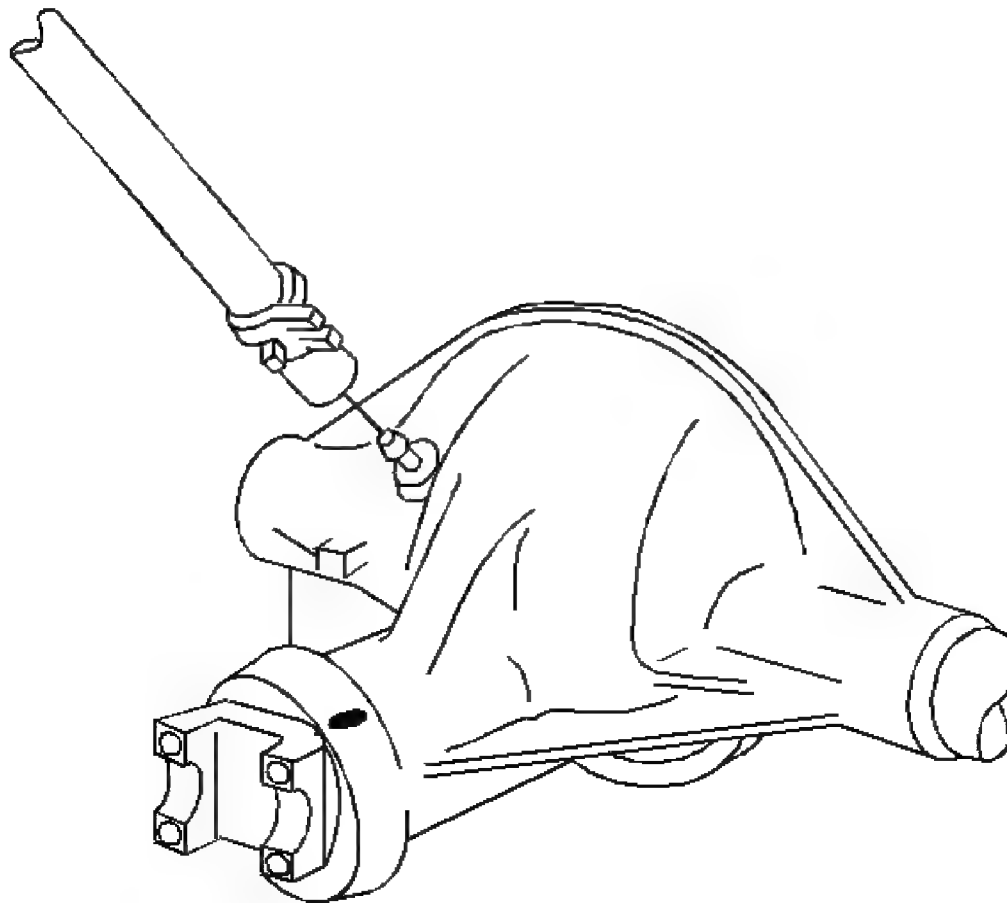


Fig. 33: View Of Hose For Axle Vent Tube
Courtesy of GENERAL MOTORS CORP.

3. Remove the hose from the axle vent tube.

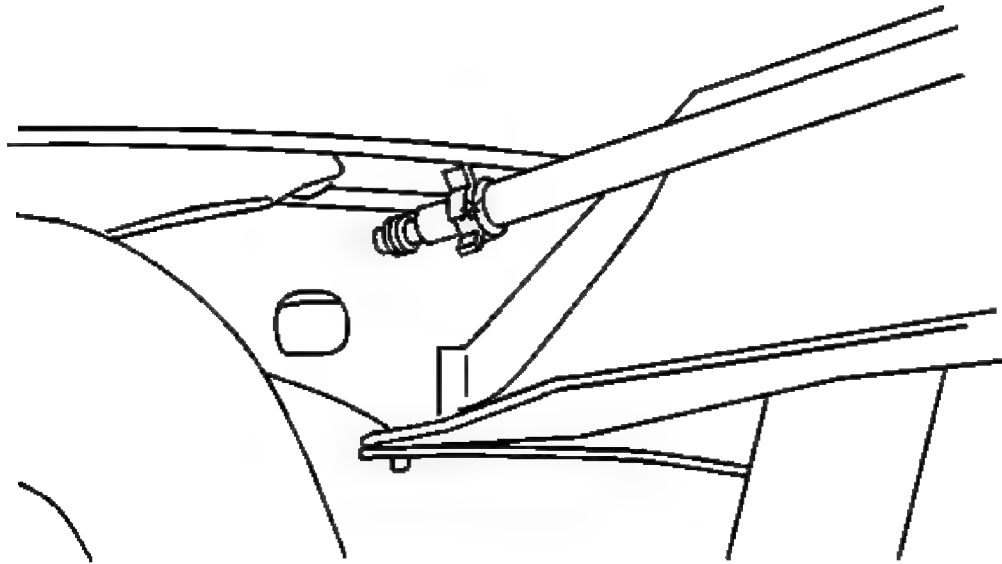


Fig. 34: View Of Vent Hose
Courtesy of GENERAL MOTORS CORP.

4. Remove the hose from the frame.
5. Remove the vent assembly from the hose.
6. Remove the vent hanger clip from the vent hose.
7. Remove the hose clamp from the vent hose.

Installation Procedure

1. Use a neoprene-type replacement vent hose.
2. Install the hose clamp to the vent hose.
3. Install the vent hanger clip to the vent hose.
4. Install the vent assembly to the vent hose.

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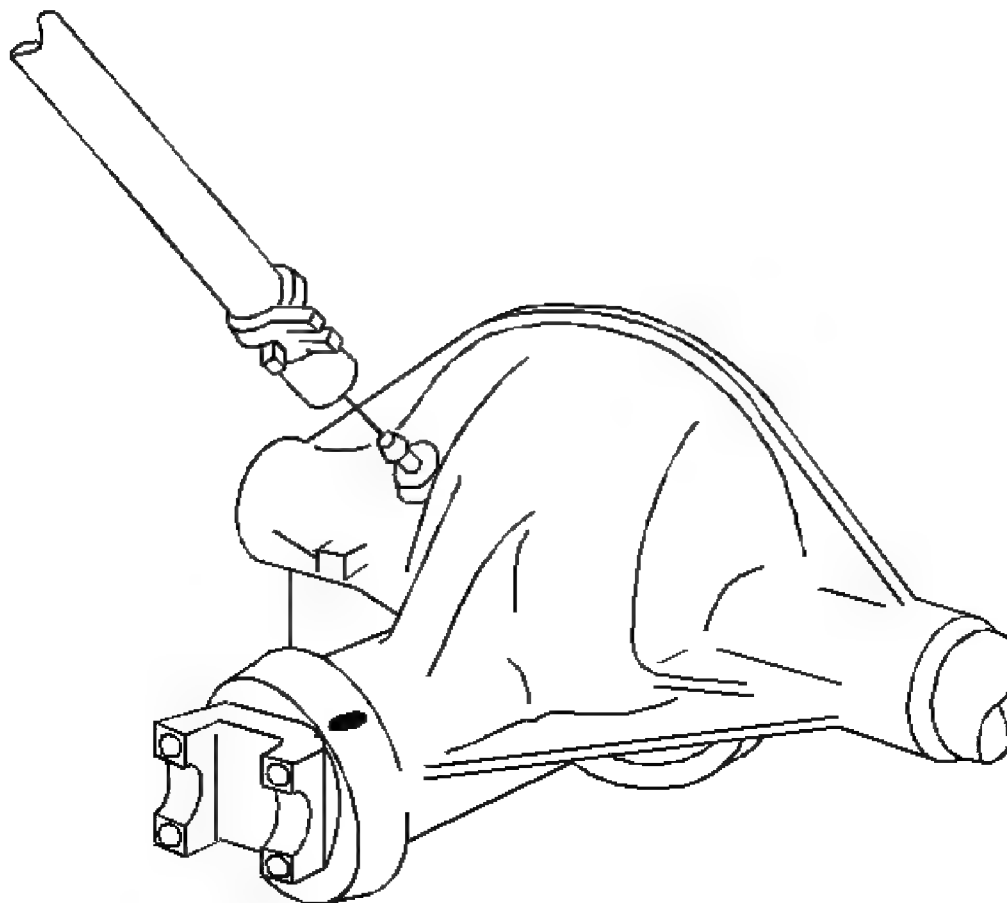


Fig. 35: View Of Hose For Axle Vent Tube
Courtesy of GENERAL MOTORS CORP.

5. Install the vent hose to the axle vent tube.
6. Install the hose clamp to the axle vent tube. Do not kink or twist the hose.

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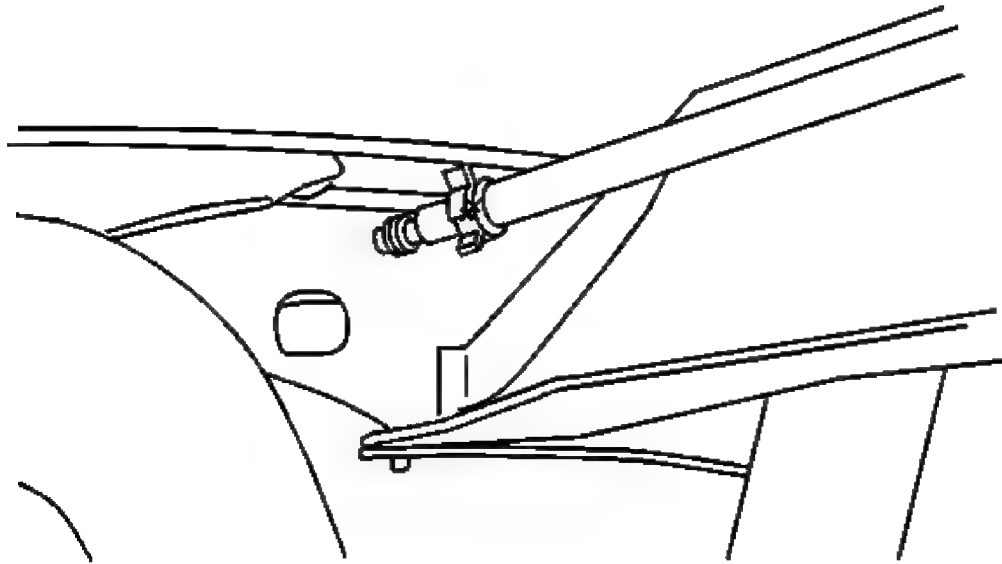


Fig. 36: View Of Vent Hose
Courtesy of GENERAL MOTORS CORP.

7. Install the hose to the frame.

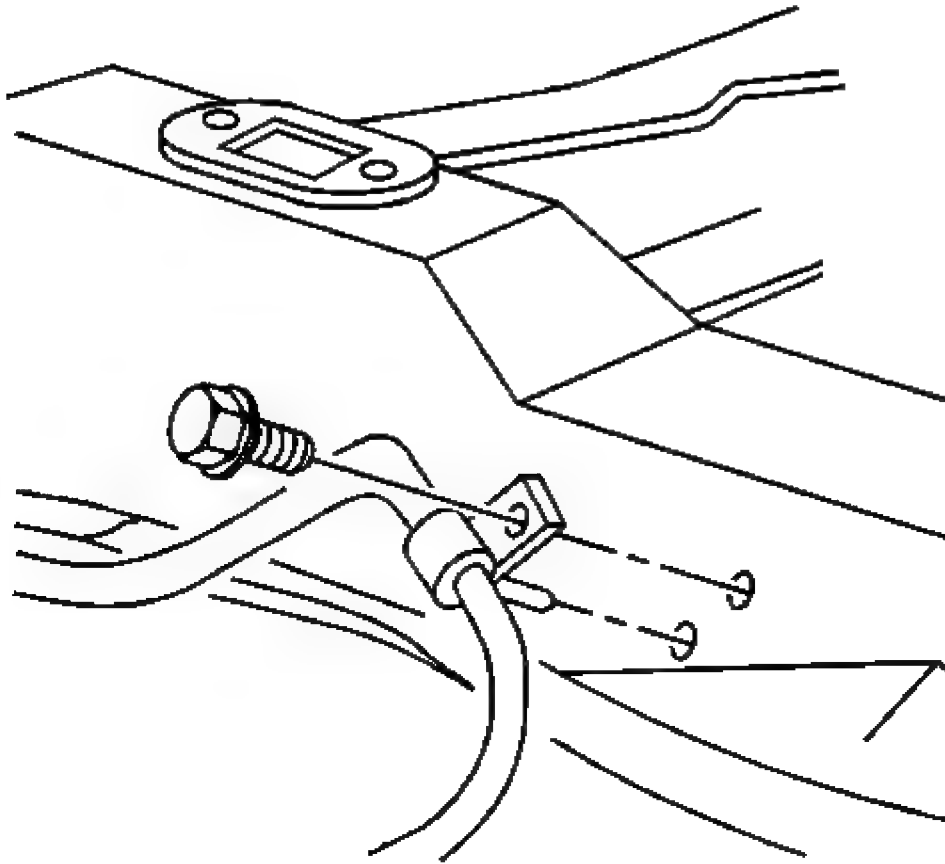


Fig. 37: View Of Vent Clamp Bolt
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice in Cautions and Notices.

8. Install the vent clamp bolt at the vent assembly.

Tighten: Tighten the bolt to 17 N.m (13 lb ft).

9. Lower the vehicle.

REAR AXLE HOUSING COVER AND GASKET REPLACEMENT

Removal Procedure

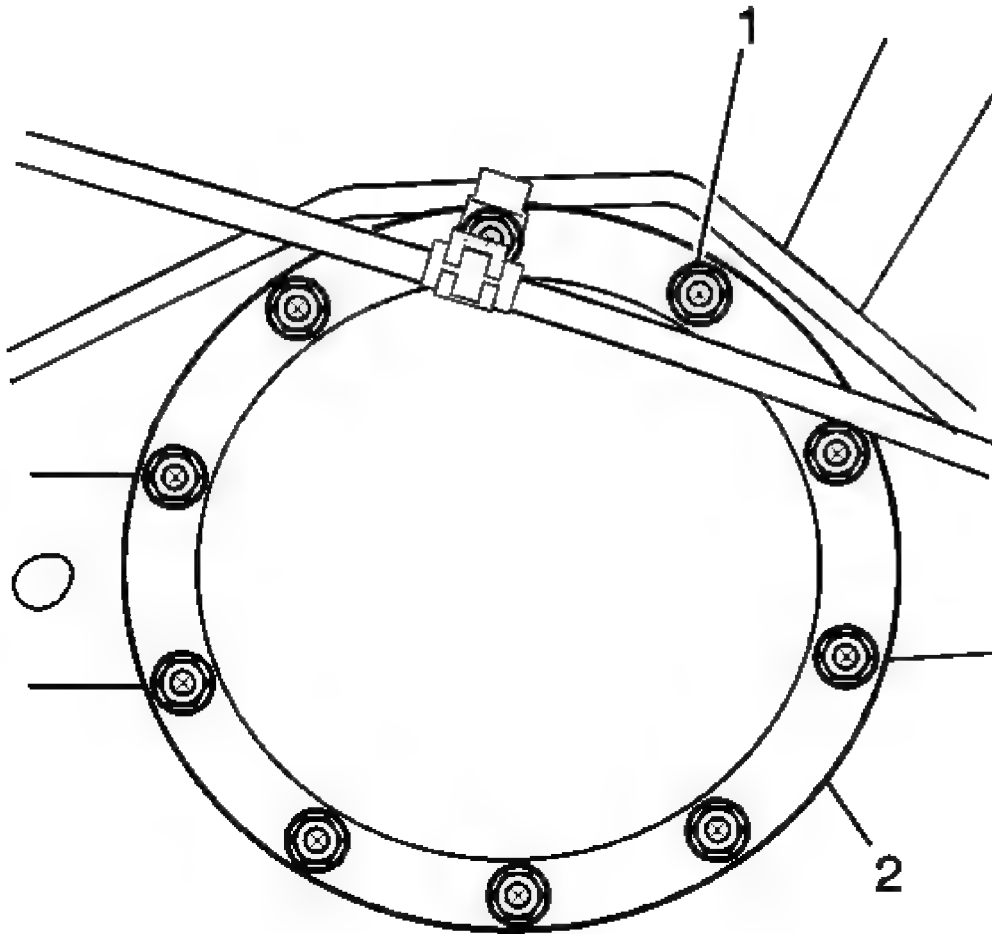


Fig. 38: Identifying Rear Axle Housing Cover & Bolts
Courtesy of GENERAL MOTORS CORP.

1. Raise the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
2. Drain the rear axle. Refer to **Lubricant Replacement - Rear Drive Axle**.
3. Remove the rear axle housing cover bolts (1).
4. Remove the rear axle housing cover (2) from the axle housing.
 - A. Catch the oil in a drain pan.
 - B. Remove any gasket material from the rear axle housing and/or the rear axle housing cover.

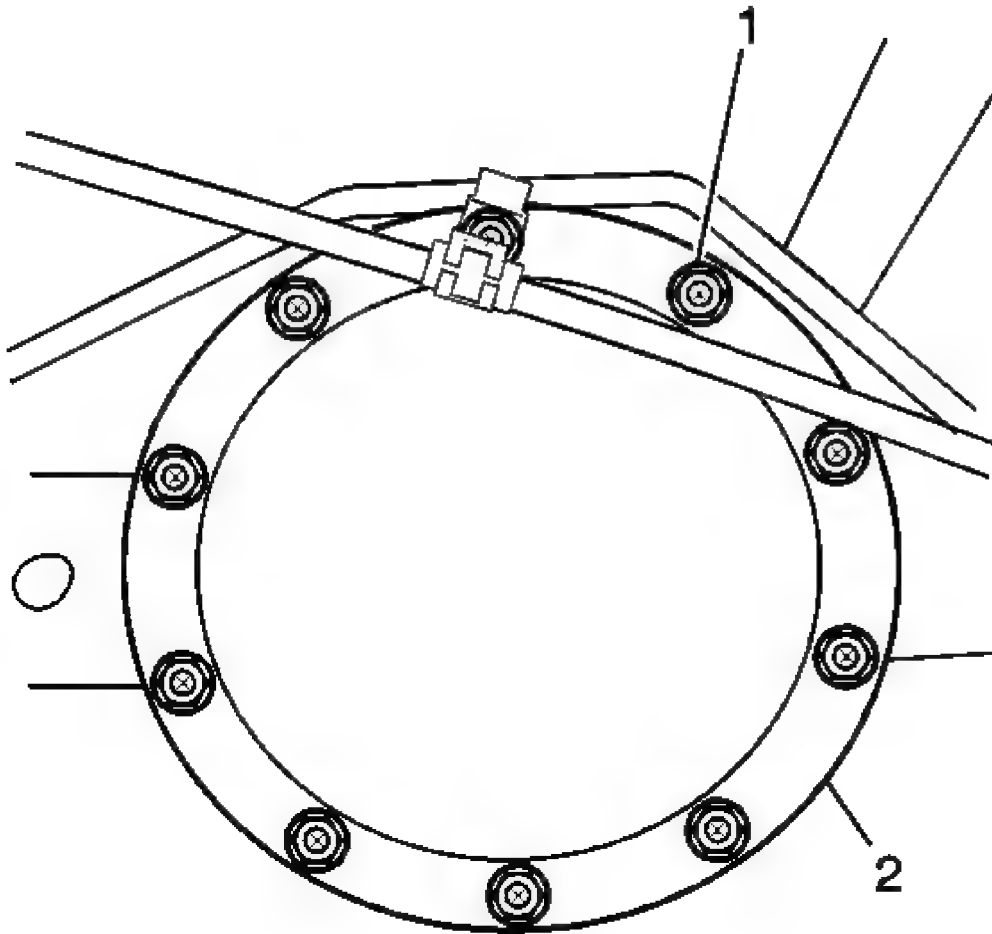


Fig. 39: Identifying Rear Axle Housing Cover & Bolts
Courtesy of GENERAL MOTORS CORP.

1. Install the rear axle housing cover (2) and a new gasket.

NOTE: Refer to Fastener Notice in Cautions and Notices.

2. Install the rear axle housing cover bolts (1).

Tighten: Tighten the rear housing cover bolts in a crosswise pattern to 39 N.m (29 lb ft).

3. Fill the rear axle. Use the proper fluid. Refer to Capacities - Approximate Fluid and Fluid and Lubricant Recommendations in Maintenance and Lubrication.

4. Lower the vehicle.

REAR AXLE SHAFT REPLACEMENT

Removal Procedure

1. Raise the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
2. Remove the tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels.
3. Remove the brake caliper. Refer to **Brake Caliper Replacement - Rear** in Disc Brakes.
4. Remove the brake rotor. Refer to **Brake Rotor Replacement - Rear** in Disc Brakes.
5. Remove the rear cover and the gasket. Refer to **Rear Axle Housing Cover and Gasket Replacement**.

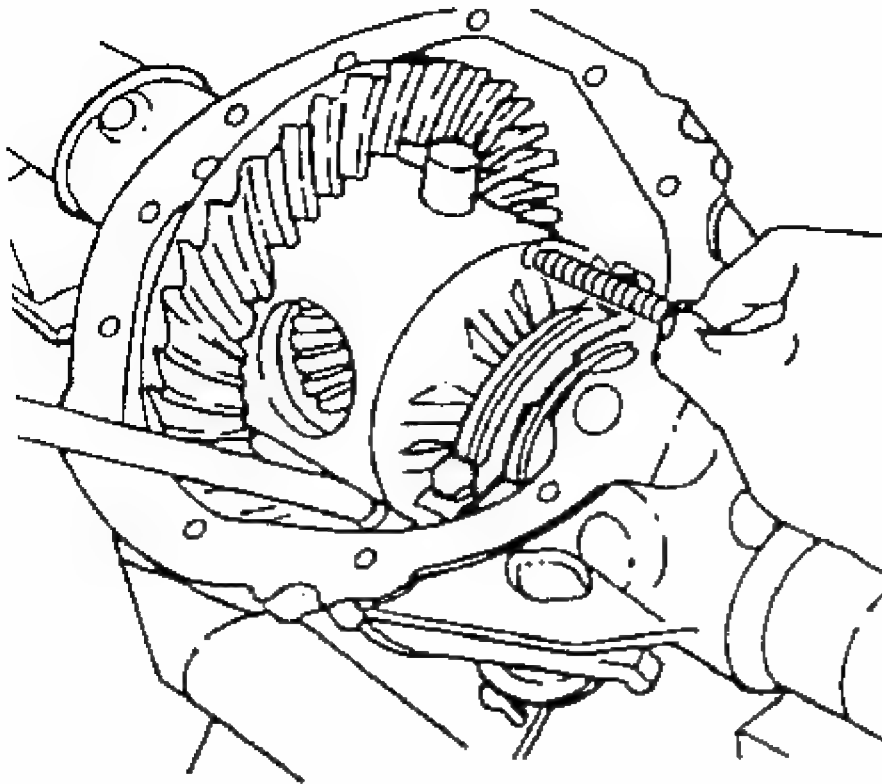


Fig. 40: View Of Pinion Shaft Locking Bolt
Courtesy of GENERAL MOTORS CORP.

6. Remove the pinion shaft locking bolt.

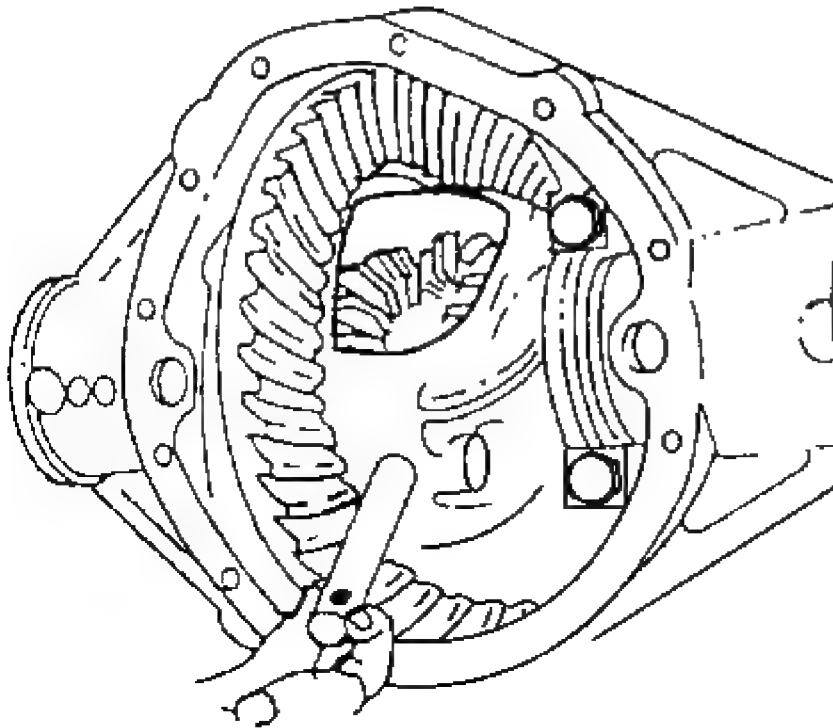


Fig. 41: View Of Pinion Shaft
Courtesy of GENERAL MOTORS CORP.

7. On axles without a locking differential, remove the pinion shaft.

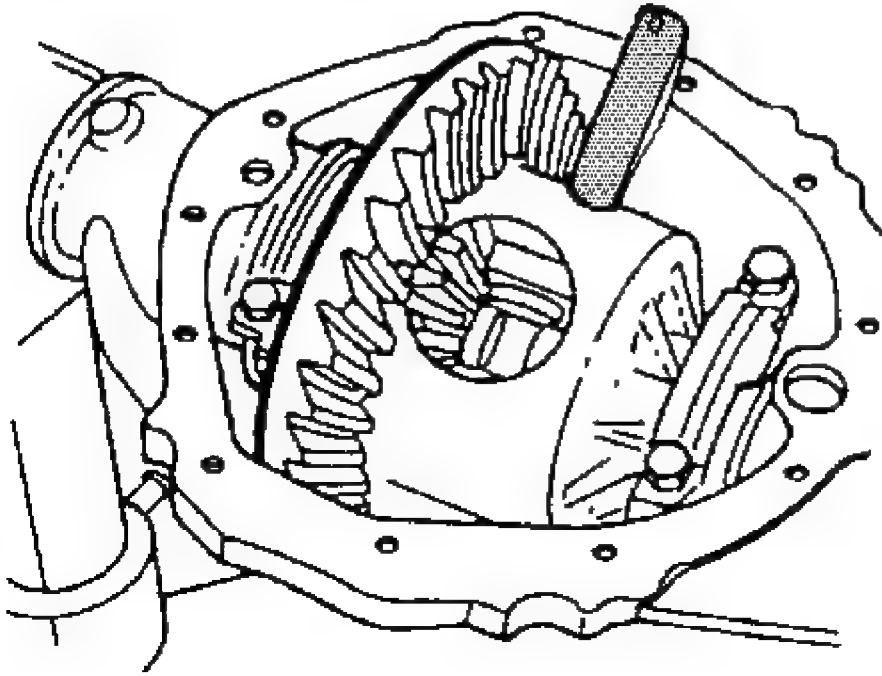


Fig. 42: View Of Pinion Shaft Contacting Axle Housing Top
Courtesy of GENERAL MOTORS CORP.

8. On axles with a locking differential, remove the shaft part way. Rotate the case until the pinion shaft touches the housing.

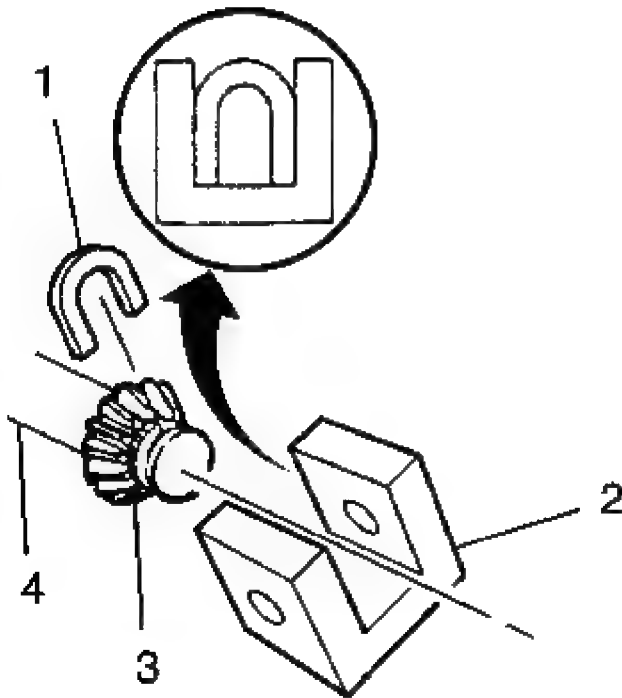


Fig. 43: View Of Axle Shaft, Lock & Thrust Block
Courtesy of GENERAL MOTORS CORP.

9. On axles with a locking differential, use a screwdriver, or a similar tool, in order to enter the differential case and rotate the rear axle shaft lock (1) until the lock aligns with the thrust block (2).
10. Push the flange of the axle shaft inward towards the differential assembly.
11. Remove the axle shaft lock from the button end of the axle shaft.

IMPORTANT: When removing the axle shaft, do not rotate the shaft. Rotating the shaft will misalign the gears. Misaligning the gears will make the assembly difficult.

12. Remove the axle shaft from the housing.

Installation Procedure

IMPORTANT: Carefully insert the axle shaft in order to not damage the seal.

1. Install the axle shaft into the rear axle housing.
2. Slide the axle shaft into the differential assembly allowing the splines to engage the differential side gear.
3. On axles without a locking differential, place the axle shaft lock on the button end of the axle shaft.

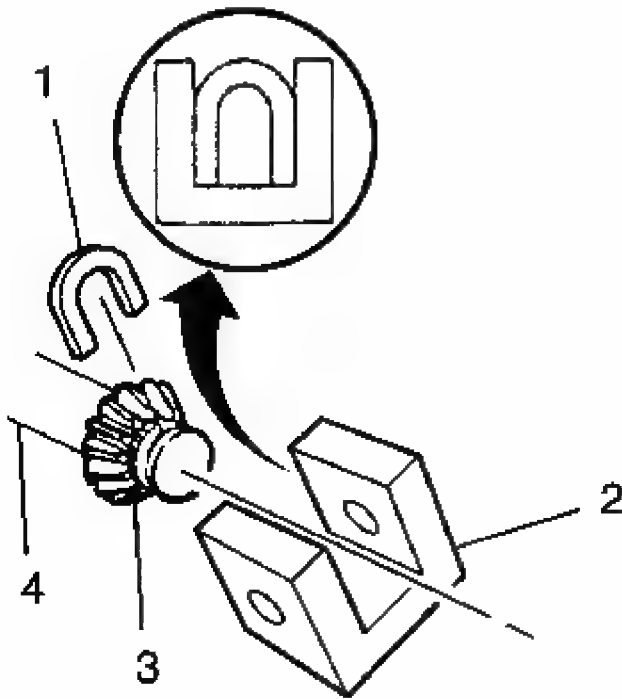


Fig. 44: View Of Axle Shaft, Lock & Thrust Block
Courtesy of GENERAL MOTORS CORP.

4. On axles with a locking differential, place the axle shaft lock (1) on the axle shaft (3) so that the ends are flush with the thrust block (2).
5. Pull the shaft flange outward in order to seat the axle shaft lock into the differential side gear.
6. Install the pinion shaft.

Align the hole in the pinion shaft with the bolt hole in the differential case.

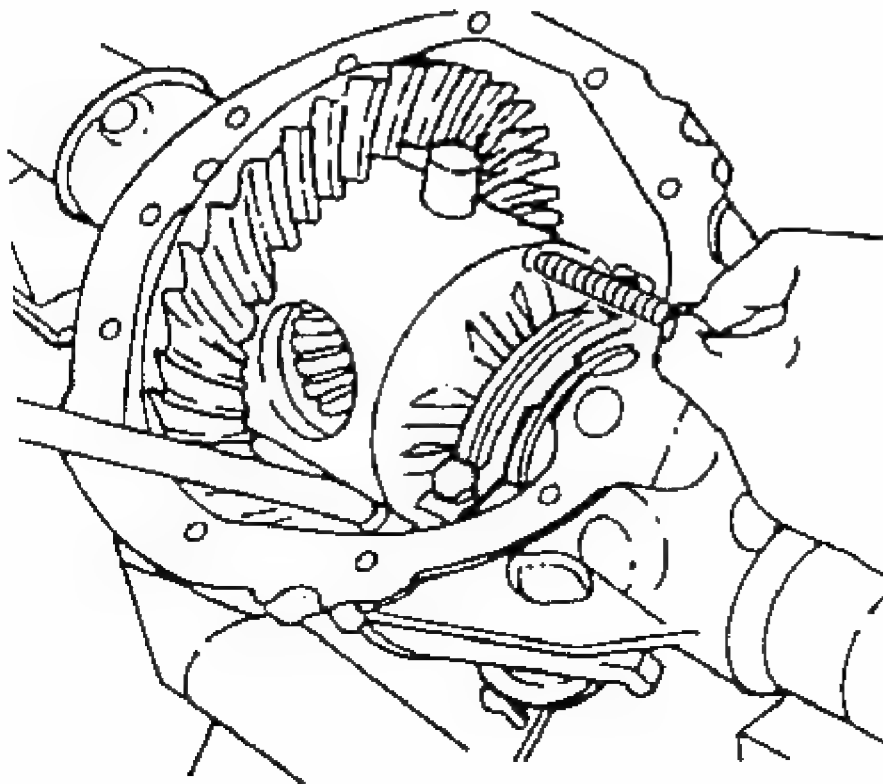


Fig. 45: View Of Pinion Shaft Locking Bolt
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice in Cautions and Notices.

7. Install the new pinion shaft lock bolt.

Tighten: Tighten the pinion shaft locking bolt to 25 N.m (18 lb ft).

8. Install the rear cover and the gasket. Refer to Rear Axle Housing Cover and Gasket Replacement.
9. Install the brake rotor. Refer to Brake Rotor Replacement - Rear in Disc Brakes.
10. Install the brake caliper. Refer to Brake Caliper Replacement - Rear in Disc Brakes.
11. Install the tire and wheel assembly. Refer to Tire and Wheel Removal and Installation in Tires and Wheels.
12. Fill the rear axle. Use the proper fluid. Refer to Capacities - Approximate Fluid and

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Fluid and Lubricant Recommendations in Maintenance and Lubrication.

13. Lower the vehicle.

REAR AXLE SHAFT SEAL AND/OR BEARING REPLACEMENT

Tools Required

- **J 8092** Driver Handle
- **J 22813-A** Axle Bearing Remover/Installer. See Special Tools and Equipment.
- **J 23771** Axle Shaft Seal Installer. See Special Tools and Equipment.
- **J 23765** Axle Shaft Bearing Installer. See Special Tools and Equipment.
- **J 2619-01** Slide Hammer. See Special Tools and Equipment.

Removal Procedure

1. Raise the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
2. Remove the tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels.
3. Remove the rear axle housing cover. Refer to **Rear Axle Housing Cover and Gasket Replacement**.
4. Remove the axle shaft. Refer to **Rear Axle Shaft Replacement**.

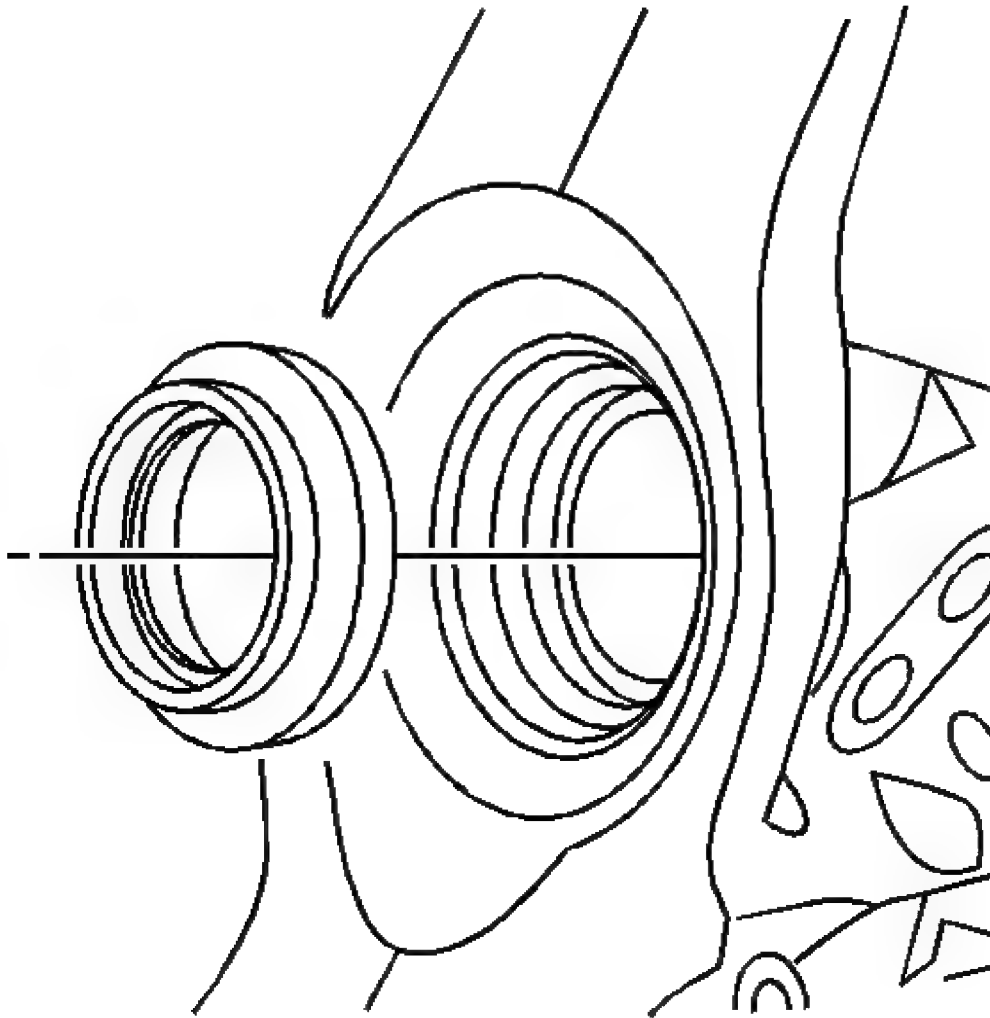


Fig. 46: View Of Axle Shaft Seal & Bearing
Courtesy of GENERAL MOTORS CORP.

5. For axles with disc brakes, remove the axle shaft seal and the bearing from the axle housing using the J 22813-A and the J 2619-01 .

Installation Procedure

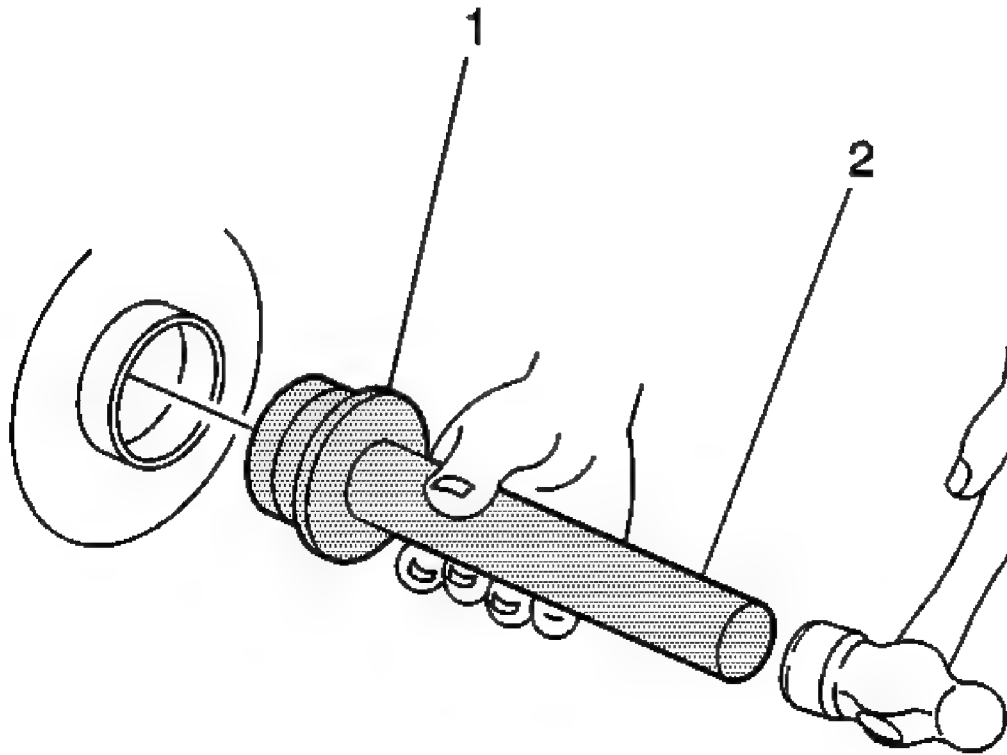


Fig. 47: Installing Axle Shaft Bearing Using J 23690 & J 8092
Courtesy of GENERAL MOTORS CORP.

1. Install the axle shaft bearing into the axle tube using the **J 23765** (1) and the **J 8092** (2).

Drive the axle shaft bearing into the axle housing until the tool bottoms against the tube.

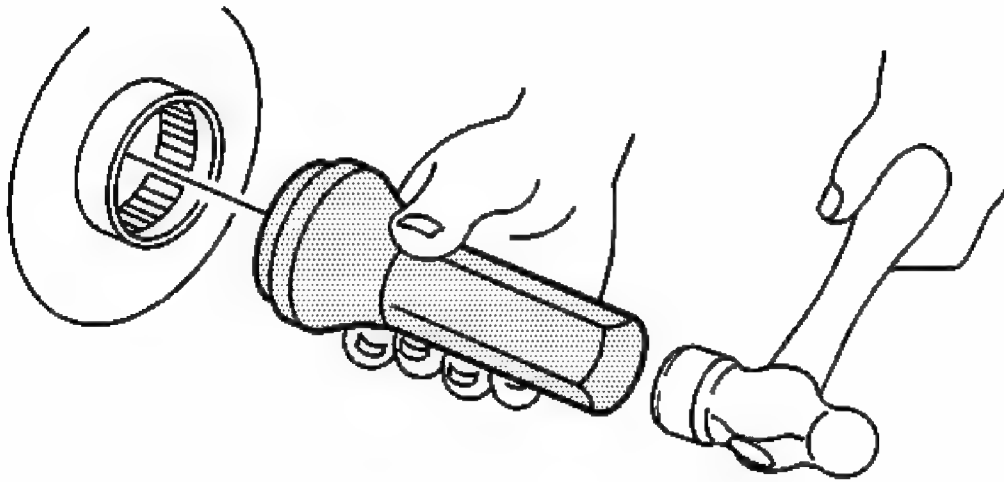


Fig. 48: Installing Axle Shaft Seal
Courtesy of GENERAL MOTORS CORP.

2. Install the axle shaft seal using the **J 23771** .

Drive the tool into the bore until the axle shaft seal bottoms flush with the tube.

3. Install the axle shaft. Refer to **Rear Axle Shaft Replacement**.
4. Install the rear axle housing cover. Refer to **Rear Axle Housing Cover and Gasket Replacement**.
5. Install the tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels.
6. Fill the rear axle. Use the proper fluid. Refer to **Capacities - Approximate Fluid** and **Fluid and Lubricant Recommendations** in Maintenance and Lubrication.
7. Lower the vehicle.

DRIVE PINION FLANGE/YOKE AND/OR OIL SEAL REPLACEMENT

Tools Required

- **J 8614-01** Flange/Pulley Holding Tool
- **J 22388** Pinion Oil Seal Installer - Rear. See **Special Tools and Equipment**.
- **J 33782** Pinion Oil Seal Installer
- **J 38694** Extension Housing Oil Pump/Seal Installer. See **Special Tools and Equipment**.

Removal Procedure

IMPORTANT: Observe and mark the positions of all the driveline components relative to the propeller shaft and the axles prior to disassembly. These components include the propeller shafts, drive axles, pinion flanges, output shafts, etc. Assemble all the components in the exact places in which you removed the parts. Follow any specifications, torque values, and measurements obtained prior to disassembly.

1. Raise the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
2. Remove the tire and wheel assemblies. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels.
3. Remove the rear brake calipers. Refer to **Brake Caliper Replacement - Rear** in Disc Brakes.
4. Remove the brake rotors. Refer to **Brake Rotor Replacement - Rear** in Disc Brakes.
5. Disconnect the propeller shaft from the drive pinion yoke. Refer to **Propeller Shaft Replacement - One Piece** or **Propeller Shaft Replacement - Two Piece** in Propeller Shaft.

Position and secure the propeller shaft away from the rear axle.

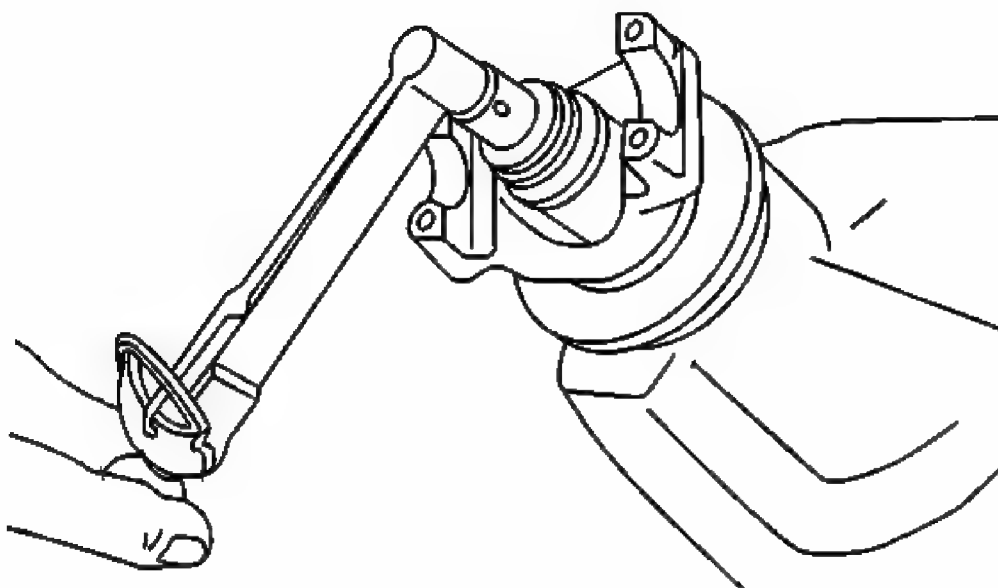


Fig. 49: Measuring Pinion Rotating Torque

Courtesy of GENERAL MOTORS CORP.

6. Measure the amount of torque required to rotate the pinion using an inch-pound torque wrench. This will give the combined preload for the following components:
 - The pinion bearings
 - The pinion seal
 - The carrier bearings
 - The axle bearings
 - The axle seals
7. Record the measurement.

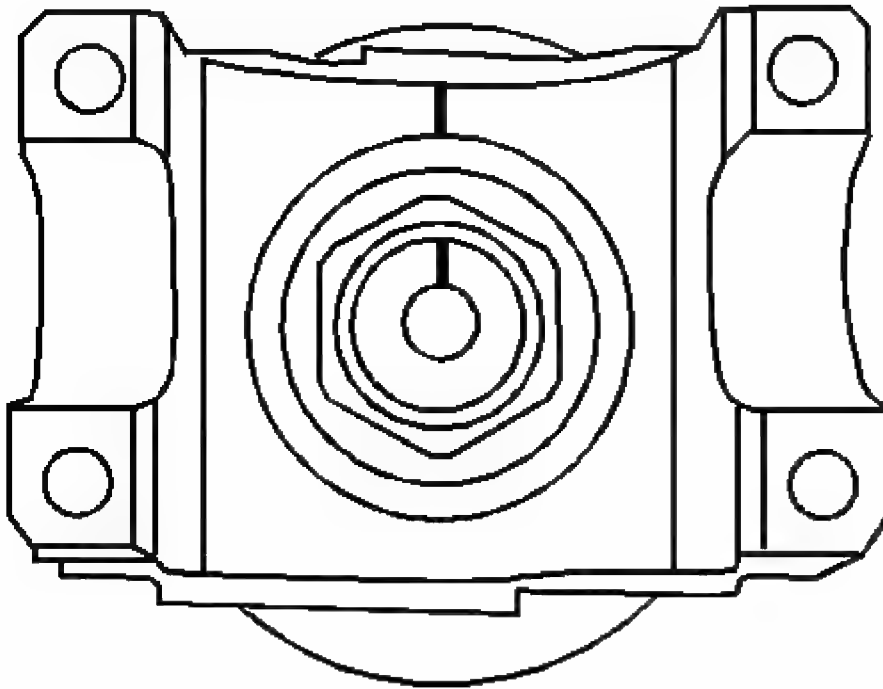


Fig. 50: View Of Pinion Shaft & Pinion Yoke Alignment Marks
Courtesy of GENERAL MOTORS CORP.

8. Draw an alignment mark between the pinion stem and the pinion flange/yoke.

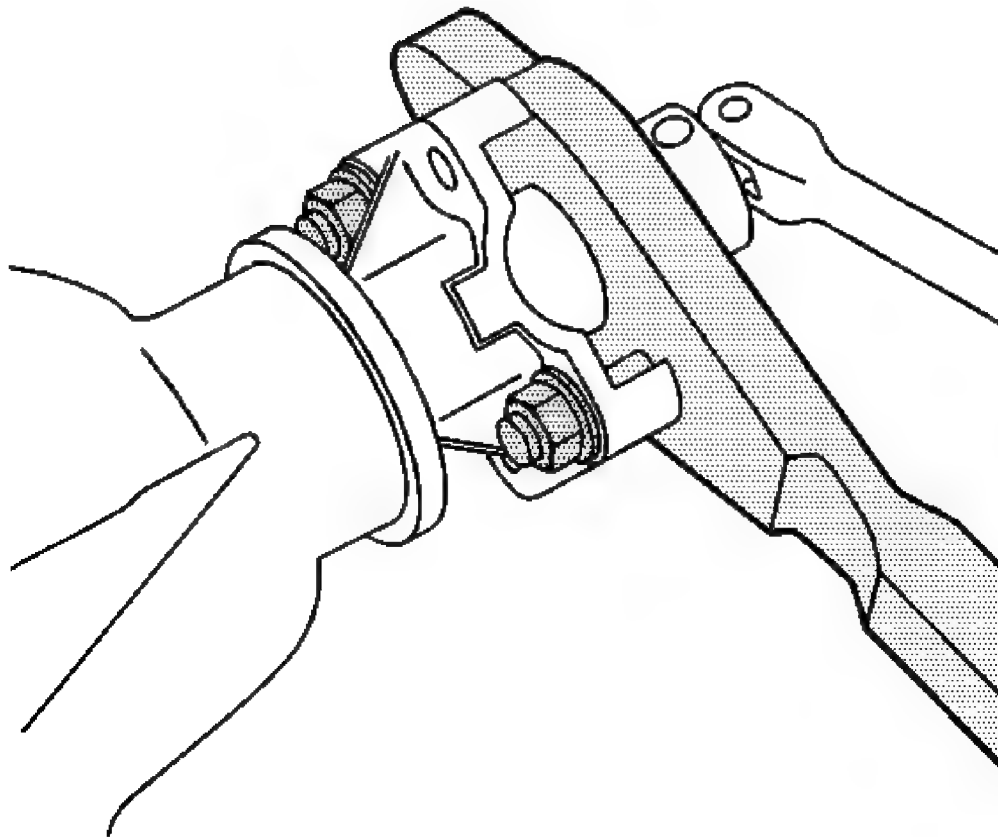


Fig. 51: Holding Pinion Yoke With Special Tool
Courtesy of GENERAL MOTORS CORP.

9. Install the **J 8614-01** as shown.
10. Remove the pinion nut while holding the **J 8614-01**.
11. Remove the washer.

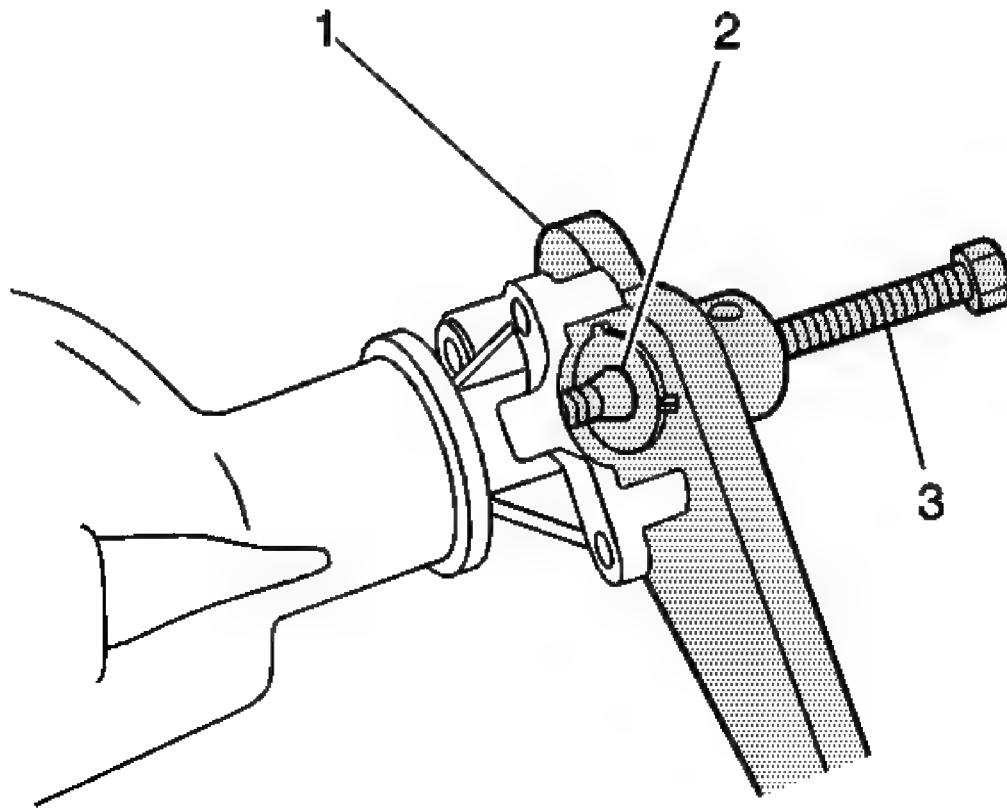


Fig. 52: Holding Pinion Yoke With Special Tool
Courtesy of GENERAL MOTORS CORP.

12. Install the J 8614-2 (2) and the J 8614-3 (3) into the **J 8614-01 (1)** as shown.
13. Remove the pinion yoke by turning the **J 8614-3 (3)** clockwise while holding the **J 8614-01 (1)**.

Use a container in order to retrieve the lubricant.

IMPORTANT: Do not damage the axle housing sealing surface.

14. Remove the pinion oil seal using a suitable seal removal tool.

Installation Procedure

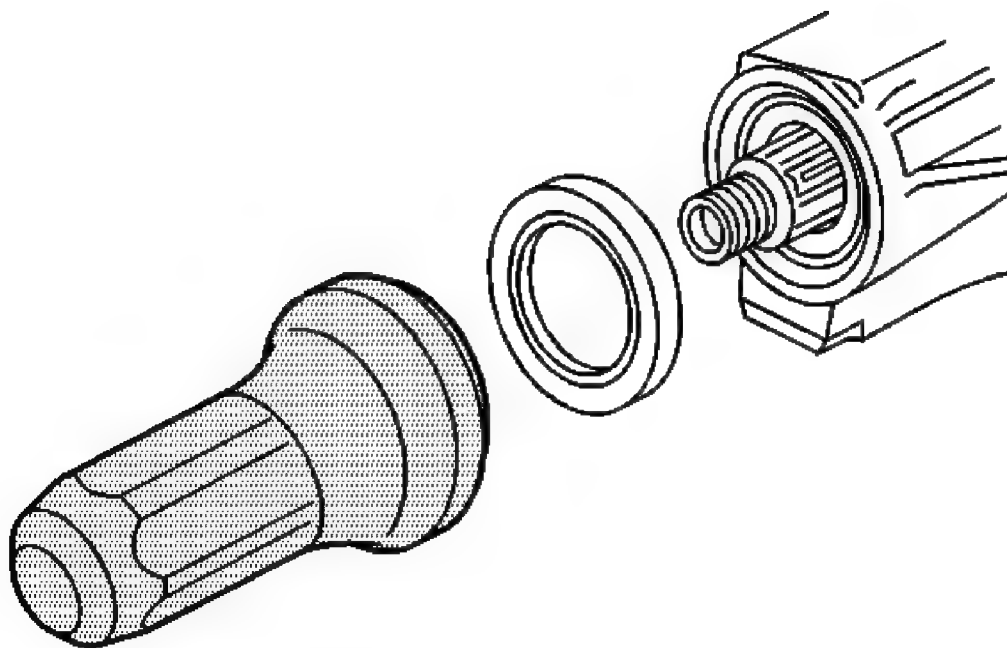


Fig. 53: Installing Pinion Oil Seal
Courtesy of GENERAL MOTORS CORP.

1. Install the new pinion oil seal using one of the following:
 - For vehicles with a 7.6 inch axle, 2-Door Utilities and 4WD Pickups w/ RPO M50 and w/o RPO ZR2, use the **J 33782** .
 - For 2-Door Utilities, use the **J 38694** (8.6 inch axle).
2. Apply sealant, GM P/N 12346004 (Canadian P/N 10953480) or equivalent, to the splines of the pinion flange/yoke.

IMPORTANT: Install the pinion gear flange/yoke to the pinion gear shaft in the same position as marked during removal in order to maintain correct driveline balance.

3. Install the pinion yoke.

Align the marks made during removal.

NOTE: Do not hammer the pinion flange/yoke onto the pinion shaft. Pinion components may be damaged if the pinion flange/yoke is hammered onto the pinion shaft.

4. Seat the pinion flange/yoke onto the pinion shaft by tapping it with a soft-faced hammer until a few pinion shaft threads show through the flange/yoke.
5. Install the washer and a new pinion nut.

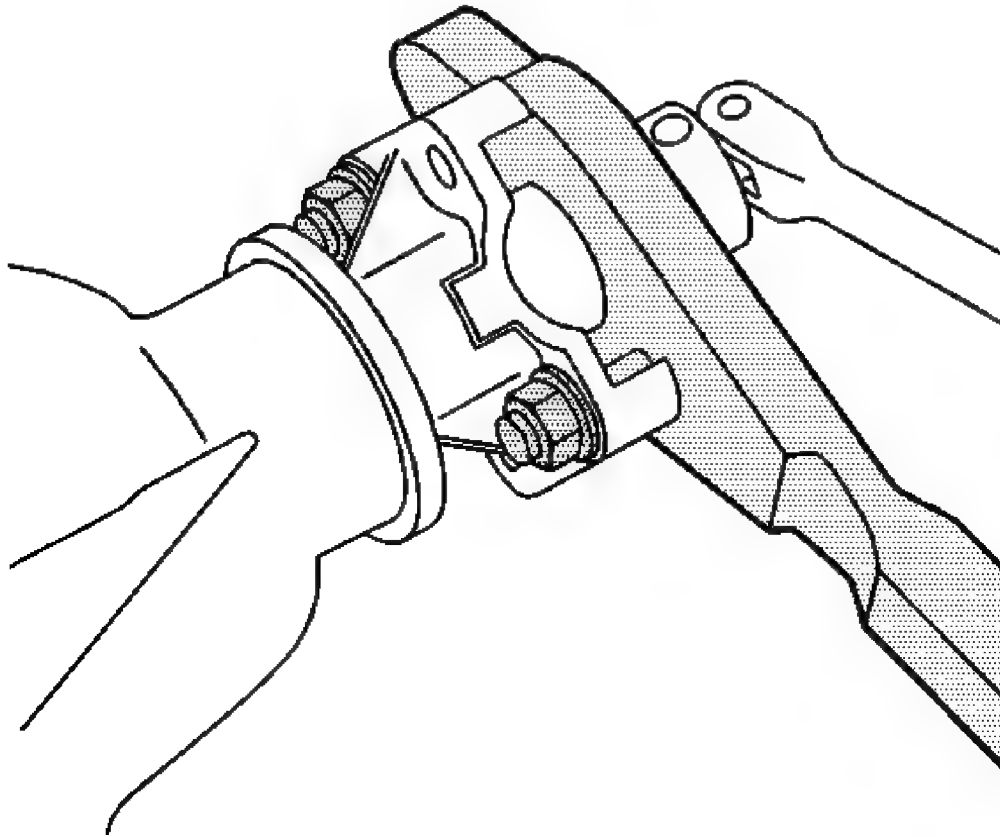


Fig. 54: Holding Pinion Yoke With Special Tool
Courtesy of GENERAL MOTORS CORP.

6. Install the **J 8614-01** onto the pinion flange/yoke as shown.

NOTE: Refer to Fastener Notice in Cautions and Notices.

IMPORTANT: If the rotating torque is exceeded, the pinion will have to be removed and a new collapsible spacer installed.

7. Tighten the pinion nut while holding the **J 8614-01**.

Tighten: Tighten the nut until the pinion end play is removed. Rotate the pinion while tightening the nut to seat the bearings.

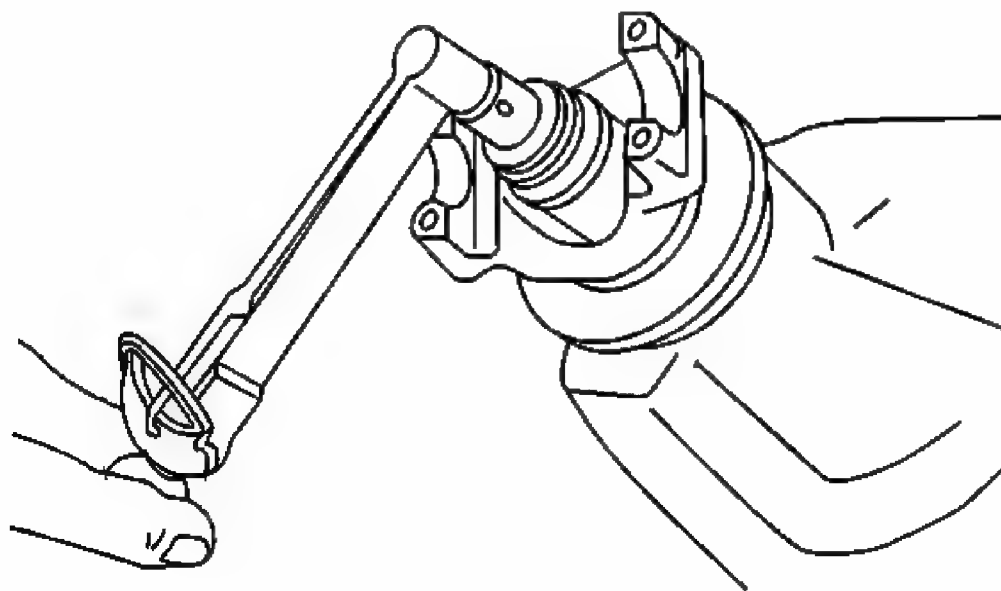


Fig. 55: Measuring Pinion Rotating Torque
Courtesy of GENERAL MOTORS CORP.

8. Measure the rotating torque of the pinion. Compare this measurement with the rotating torque recorded during removal.

Tighten: Tighten the nut in small increments, as needed, until the rotating torque is 0.40-0.57 N.m (3-5 lb in) greater than the rotating torque recorded during removal.

9. Once the specified torque is obtained, rotate the pinion several times to ensure the bearings have seated. Check the rotating torque and adjust if necessary.
10. Install the propeller shaft to the drive pinion flange/yoke. Refer to **Propeller Shaft Replacement - One Piece** or **Propeller Shaft Replacement - Two Piece** in Propeller Shaft.
11. Install the brake rotors. Refer to **Brake Rotor Replacement - Rear** in Disc Brakes.
12. Install the brake calipers. Refer to **Brake Caliper Replacement - Rear** in Disc Brakes.
13. Install the tire and wheel assemblies. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels.
14. Inspect and add axle lubricant to the axle housing, if necessary. Refer to **Lubricant Level Inspection - Rear Drive Axle (7.6 Inch Axle)** or **Lubricant Level Inspection -**

Rear Drive Axle (8.6 Inch Axle).

15. Lower the vehicle.

DRIVE PINION AND RING GEAR REPLACEMENT

Tools Required

J 22536 Pinion Driver. See **Special Tools and Equipment.**

Removal Procedure

1. Raise the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
2. Remove the tire and wheel assemblies. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels.
3. Remove the brake calipers. Refer to **Brake Caliper Replacement - Rear** in Disc Brakes.
4. Remove the brake rotors. Refer to **Brake Rotor Replacement - Rear** in Disc Brakes.
5. Remove the axle shafts. Refer to **Rear Axle Shaft Replacement.**
6. Remove the differential assembly. Refer to **Differential Replacement.**
7. Remove the drive pinion flange/yoke and the oil seal. Refer to **Drive Pinion Flange/Yoke and/or Oil Seal Replacement.**

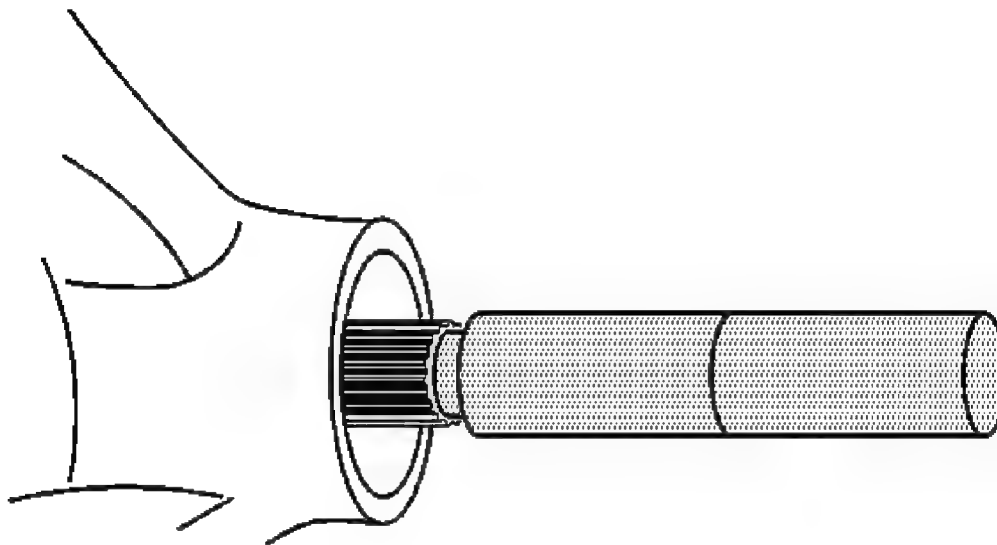


Fig. 56: Installing J 22536 Or J 44421 On Pinion
Courtesy of GENERAL MOTORS CORP.

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8. Install the **J 22536** as shown.

Ensure that the **J 22536** is firmly seated on the pinion.

9. Drive the pinion out using the **J 22536** and a hammer.

Strike the **J 22536** slowly. Do not let the pinion fall out of the rear axle housing.

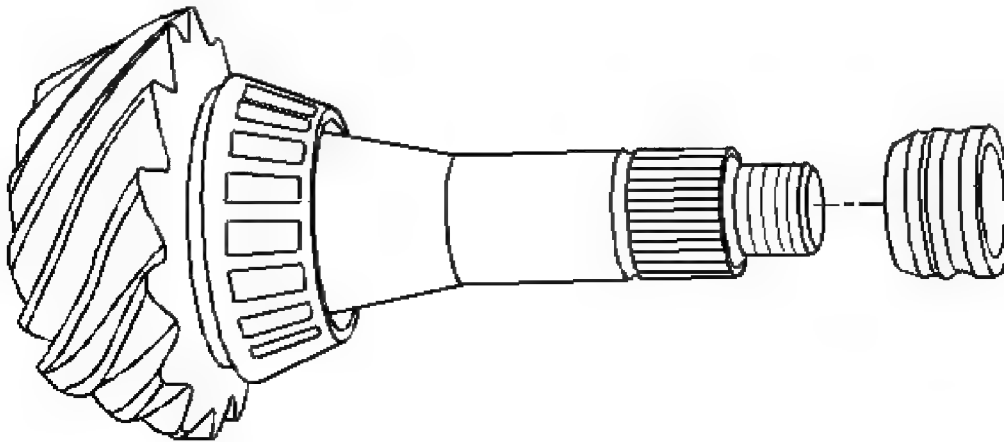


Fig. 57: View Of Collapsible Spacer & Pinion
Courtesy of GENERAL MOTORS CORP.

10. Remove the collapsible spacer from the pinion. Discard the spacer.
11. Remove the pinion bearings and the cups. Refer to **Drive Pinion Bearings Replacement**.

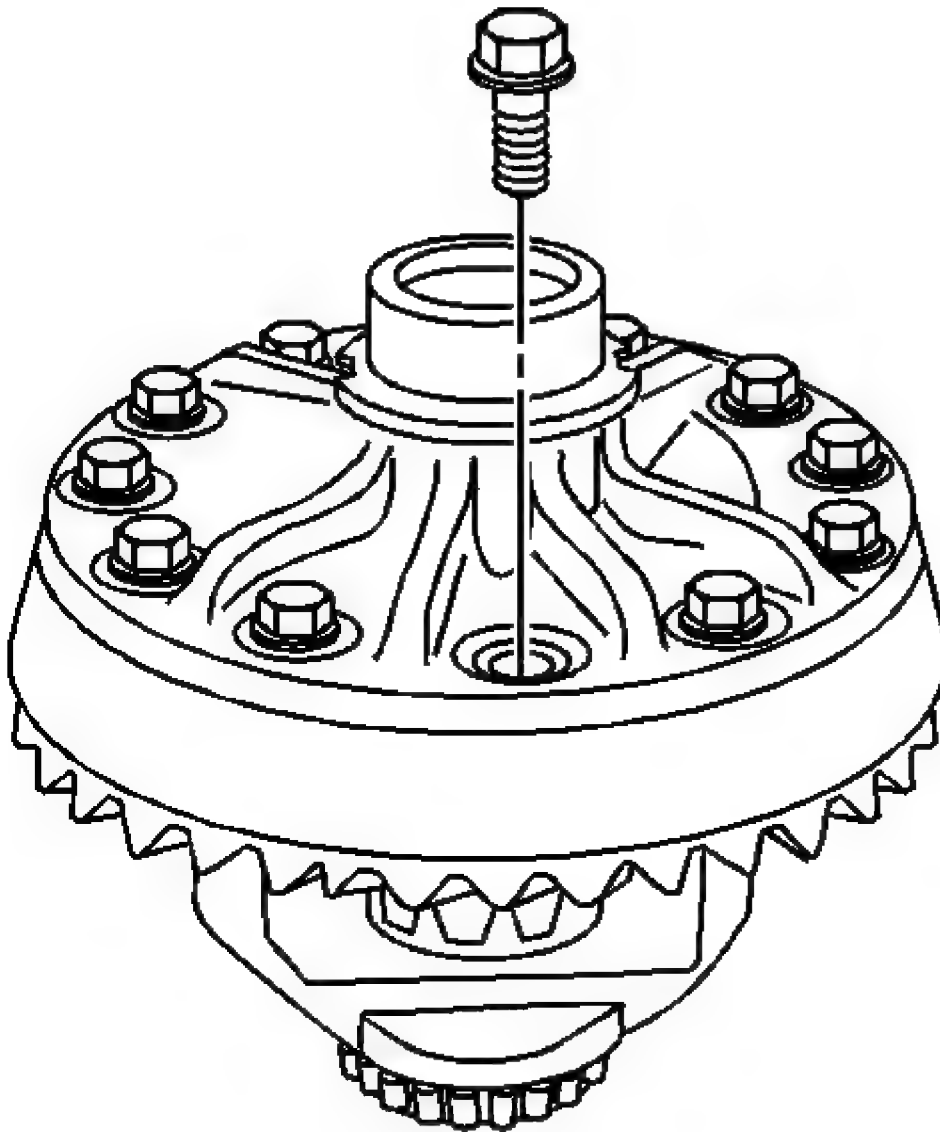


Fig. 58: Identifying Ring Gear Bolts
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: The ring gear bolts have left-hand threads.

12. Remove the ring gear bolts. Discard the bolts.

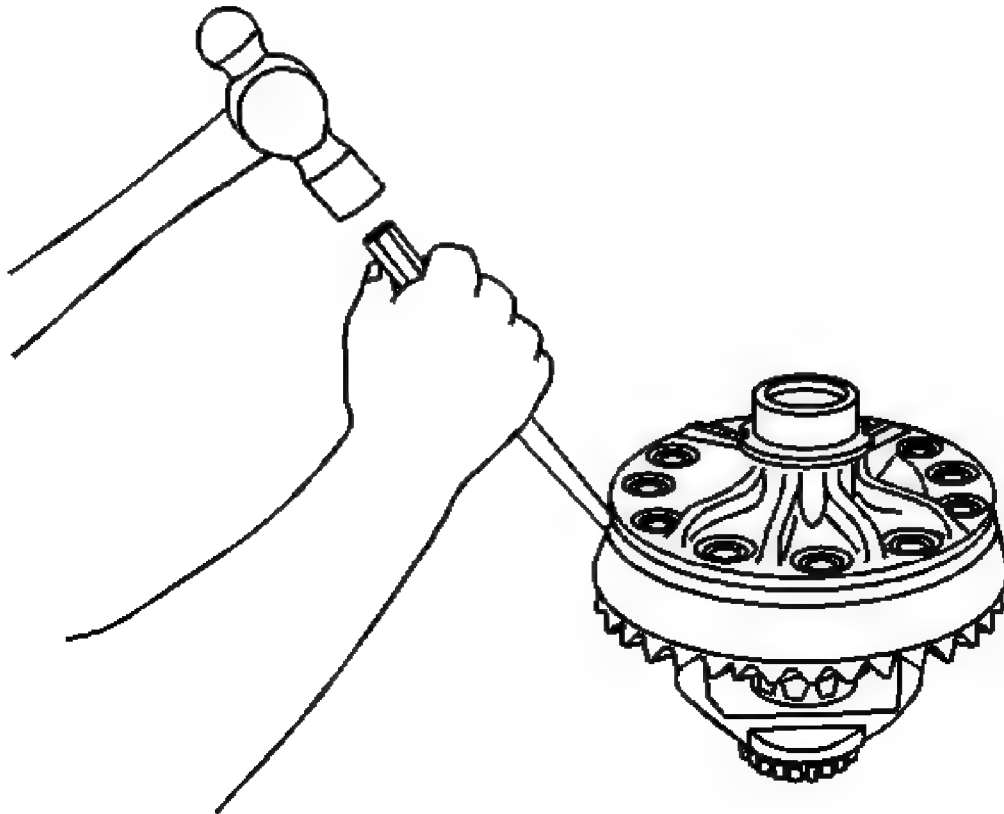


Fig. 59: Removing Ring Gear From Differential
Courtesy of GENERAL MOTORS CORP.

13. Remove the ring gear from the differential case.

Drive the ring gear off with a brass drift if necessary.

Installation Procedure

IMPORTANT: The mating surface of the ring gear and the differential case must be clean and free of burrs before installing the ring gear.

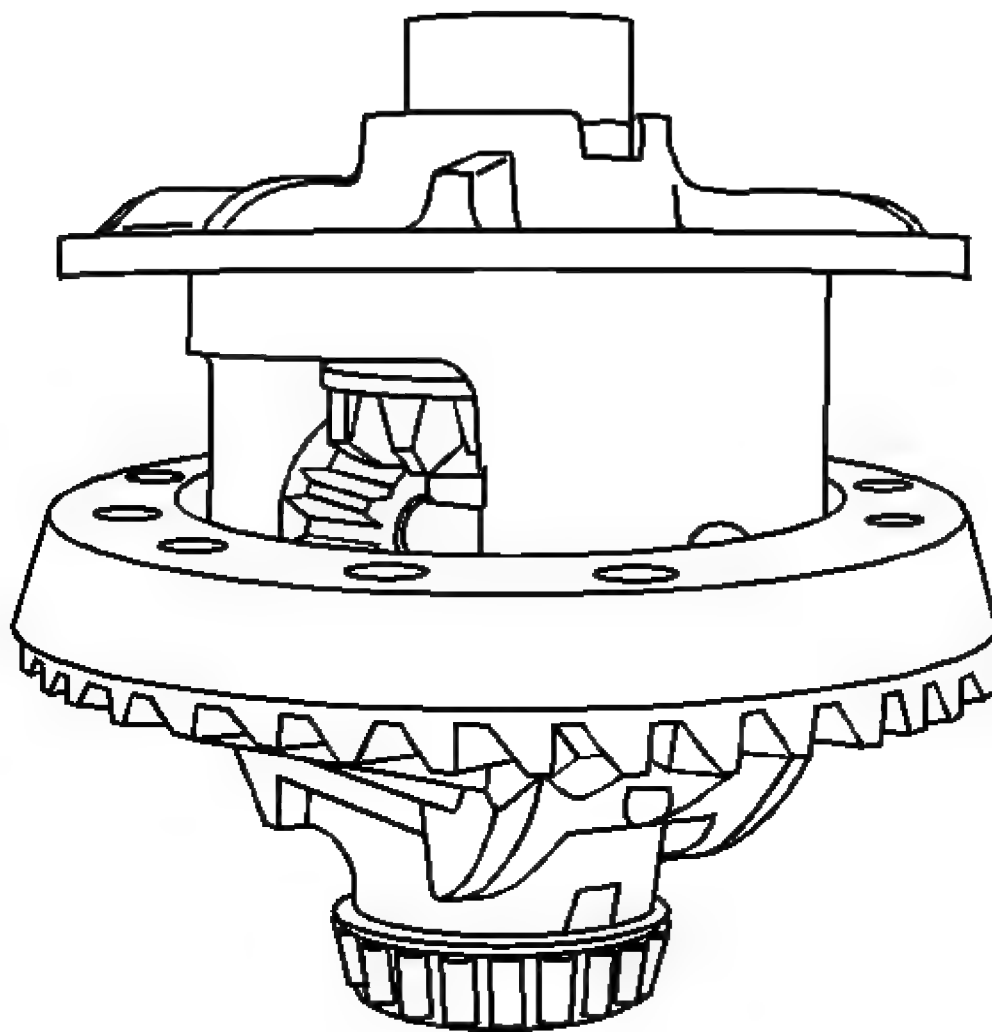


Fig. 60: Ring Gear & Differential Case
Courtesy of GENERAL MOTORS CORP.

1. Install the ring gear onto the differential case.

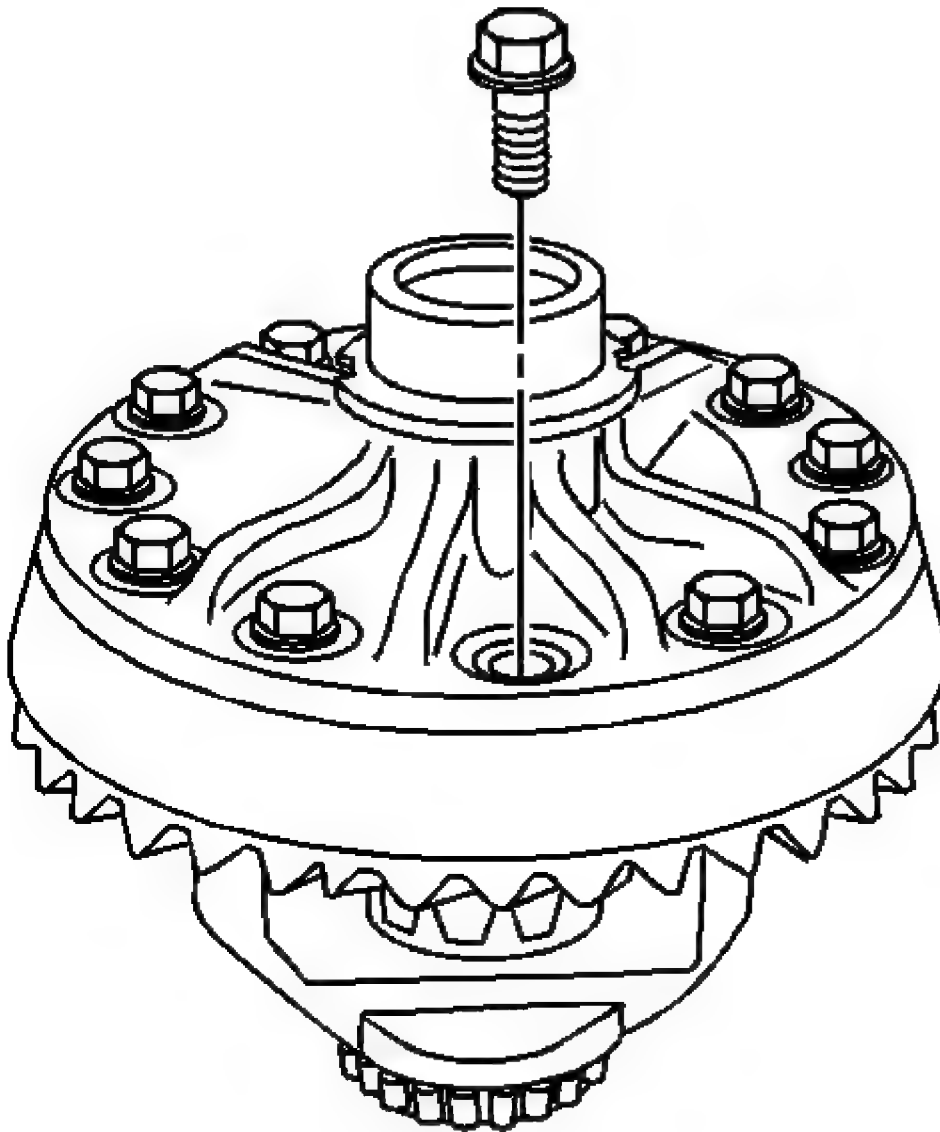


Fig. 61: Identifying Ring Gear Bolts
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: The ring gear bolts have left-hand threads.

2. Install the new ring gear bolts.

Hand start each bolt to ensure that the ring gear is properly installed to the differential

case.

NOTE: Refer to Fastener Notice in Cautions and Notices.

3. Tighten the ring gear bolts. Tighten the ring gear bolts alternately and in stages, gradually pulling the ring gear onto the differential case.

Tighten: Tighten the ring gear bolts in sequence to 120 N.m (89 lb ft).

4. Install the pinion bearing cups. Refer to Drive Pinion Bearings Replacement.
5. Determine the selective shim thickness for the pinion gear. Refer to Pinion Depth Adjustment.
6. Install the selective shim onto the pinion.
7. Install the inner pinion bearing to the pinion. Refer to Drive Pinion Bearings Replacement.
8. Install a new collapsible spacer.
9. Lubricate the pinion bearings with axle lubricant. Refer to Fluid and Lubricant Recommendations in Maintenance and Lubrication.
10. Install the pinion to the axle housing.
11. Install the outer pinion bearing.
12. Install a new pinion oil seal and the pinion yoke. Refer to Drive Pinion Flange/Yoke and/or Oil Seal Replacement.
13. Install the differential assembly. Refer to Differential Replacement.
14. Perform a gear tooth contact pattern check on the pinion and the ring gear. Refer to Gear Tooth Contact Pattern Inspection.
15. Install the axle shafts. Refer to Rear Axle Shaft Replacement.
16. Install the brake rotors. Refer to Brake Rotor Replacement - Rear in Disc Brakes.
17. Install the brake calipers. Refer to Brake Caliper Replacement - Rear in Disc Brakes.
18. Install the tire and wheel assemblies. Refer to Tire and Wheel Removal and Installation in Tires and Wheels.
19. Fill the axle with lubricant. Use the proper fluid. Refer to Fluid and Lubricant Recommendations and Capacities - Approximate Fluid in Maintenance and Lubrication.
20. Lower the vehicle.

DRIVE PINION BEARINGS REPLACEMENT

Tools Required

- **J 5590** Rear Pinion Bearing Race Installer (7. See Special Tools and Equipment.6

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inch axle)

- **J 7817** Outer Bearing Race Installer (7. See Special Tools and Equipment.6 inch axle)
- **J 8092** Driver Handle
- **J 8611-01** Rear Pinion Bearing Race Installer (8. See Special Tools and Equipment.6 inch axle)
- **J 22912-01** Split Plate Bearing Puller
- **J 24433** Pinion Cone and Side Bearing Installer (8. See Special Tools and Equipment.6 inch axle)
- **J 29609** Rear Pinion Bearing Cup Installer (7. See Special Tools and Equipment.6 inch axle)
- **J 45870** Pinion Bearing Cup Installer (8. See Special Tools and Equipment.6 inch axle)
- **J 45871** Pinion Bearing Remover. See Special Tools and Equipment.

Removal Procedure

1. Raise the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
2. Remove the tire and wheel assemblies. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels.
3. Remove the brake calipers. Refer to **Brake Caliper Replacement - Rear** in Disc Brakes.
4. Remove the brake rotors. Refer to **Brake Rotor Replacement - Rear** in Disc Brakes.
5. Remove the axle shafts. Refer to **Rear Axle Shaft Replacement**.
6. Remove the differential assembly. Refer to **Differential Replacement**.
7. Remove the drive pinion from the axle. Refer to **Drive Pinion and Ring Gear Replacement**.

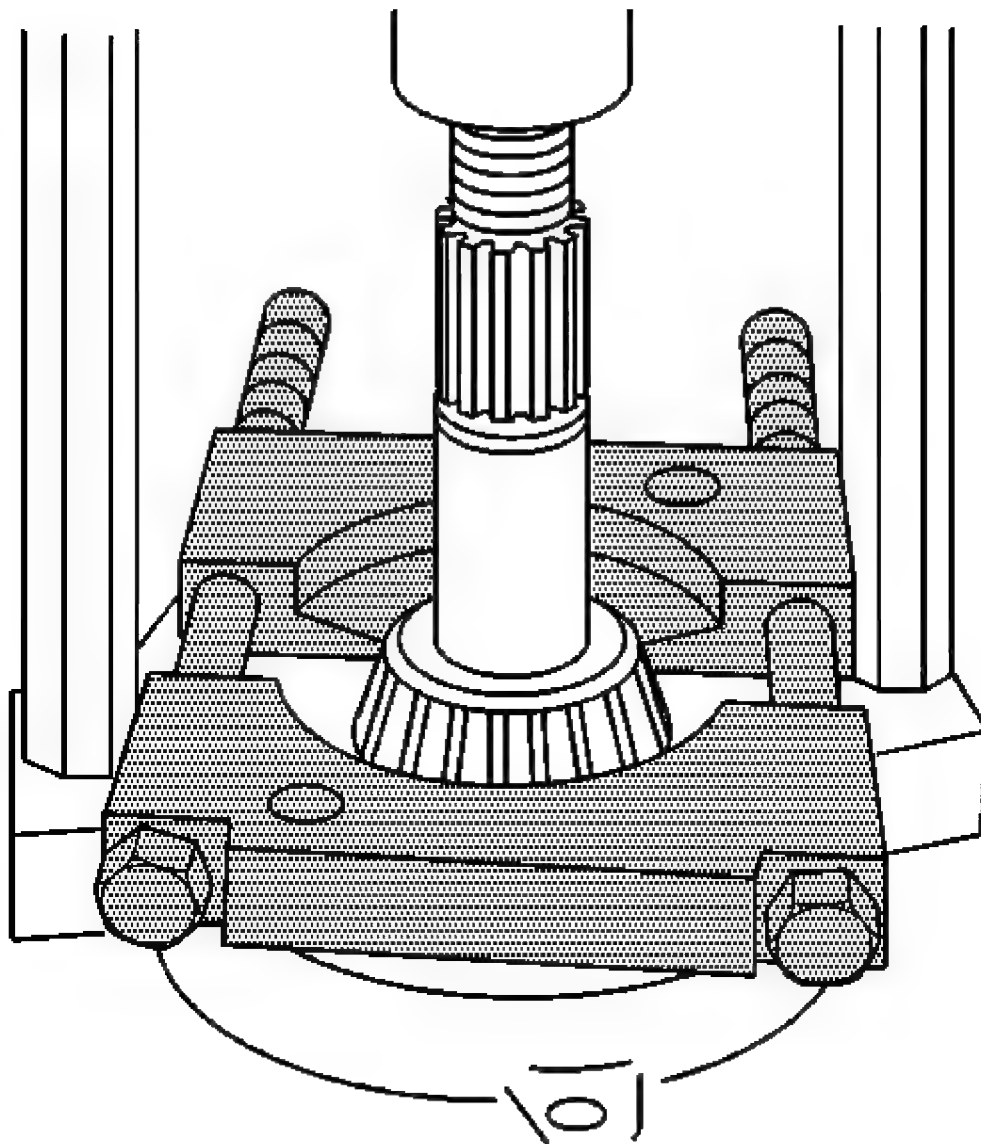


Fig. 62: Removing Inner Pinion Bearing Using Hydraulic Press
Courtesy of GENERAL MOTORS CORP.

8. For 7.6 inch axles, press the bearing off of the pinion using the J 22912-01 .

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9. For 8.6 inch axles, install the **J 45871** (1) around the pinion bearing and the **J 22912-01** (2) in the inverted position around the **J 45871** .
10. Press the bearing off of the pinion using the **J 45871** and the **J 22912-01** .
11. Remove the shim.

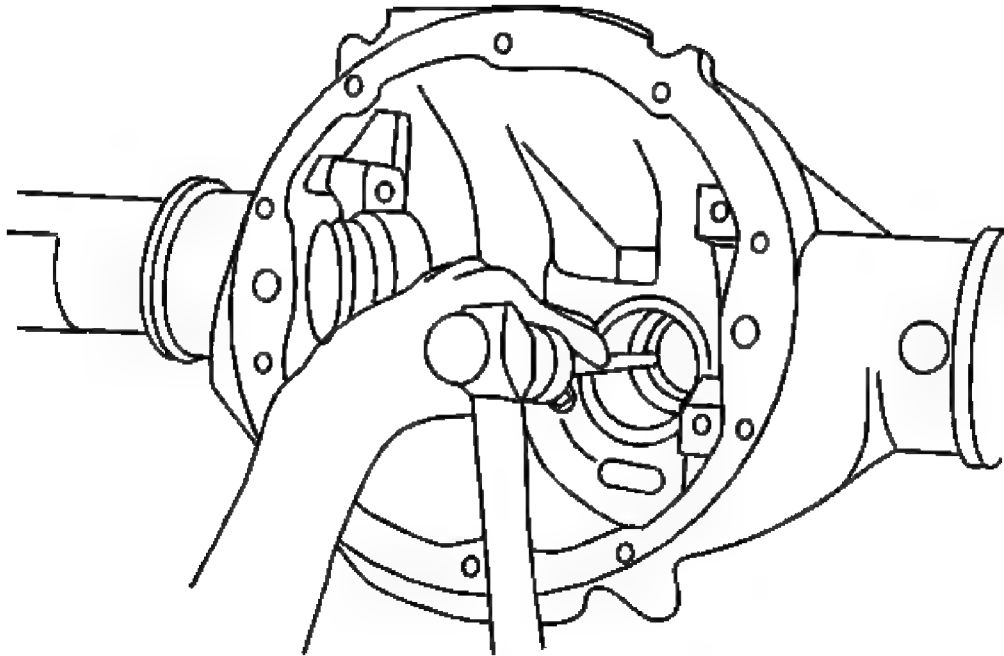


Fig. 64: View Of Outer Pinion Bearing Cup
Courtesy of GENERAL MOTORS CORP.

12. Remove the outer pinion bearing cup from the axle housing using a hammer and brass drift in the slots provided. Move the drift back and forth between one side of the cup and the other in order to evenly work the cup out of the housing.

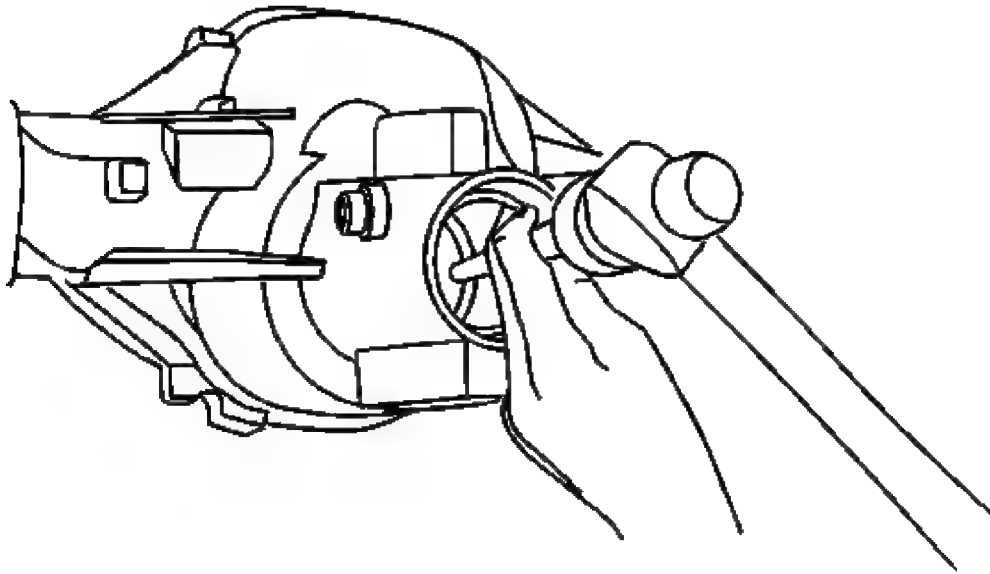


Fig. 65: View Of Inner Pinion Bearing Cup
Courtesy of GENERAL MOTORS CORP.

13. Remove the inner pinion bearing cup from the axle housing using a hammer and brass drift in the slots provided. Move the drift back and forth between one side of the cup and the other in order to evenly work the cup out of the housing.

Installation Procedure

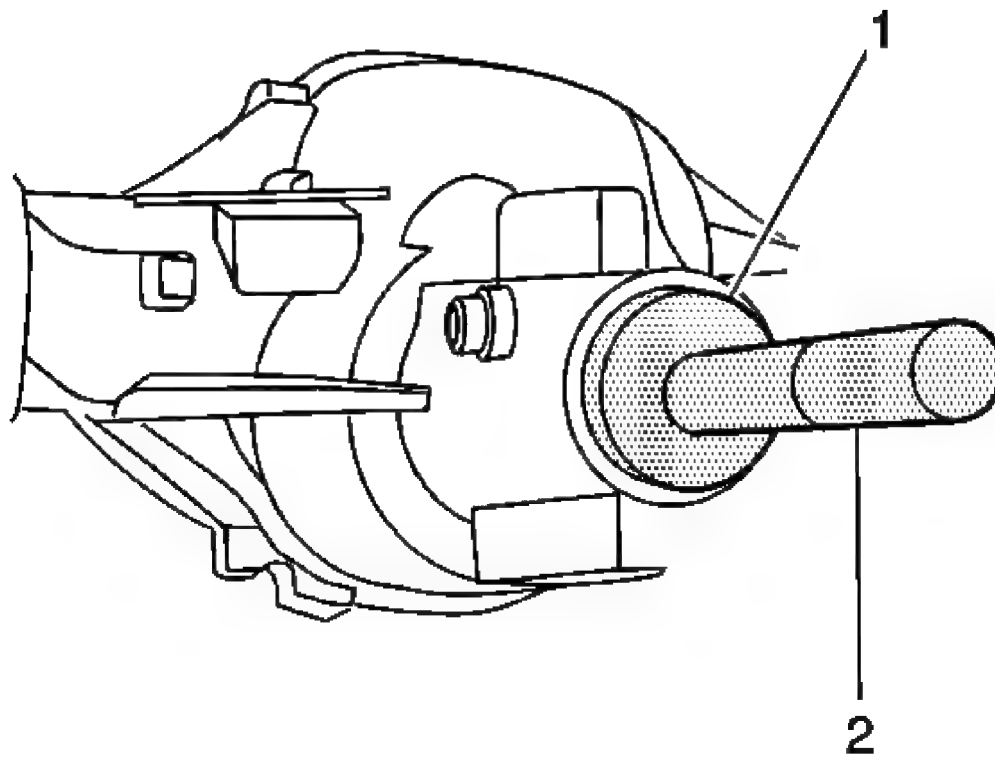


Fig. 66: Installing Outer Pinion Bearing Cup
Courtesy of GENERAL MOTORS CORP.

1. Install the outer pinion bearing cup using the **J 7817** (7.6 inch axle) or the **J 8611-01** (all 8.6 inch axles) (1) and the **J 8092** (2).

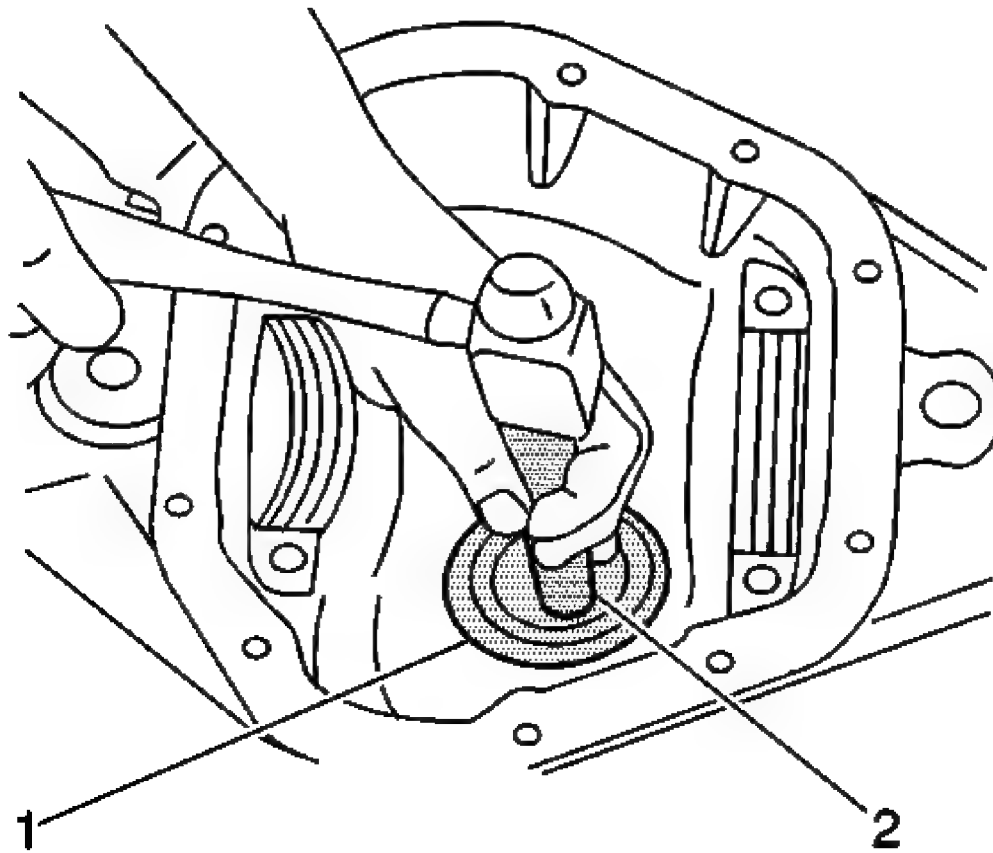


Fig. 67: Installing Inner Pinion Bearing Cup
Courtesy of GENERAL MOTORS CORP.

2. Install the inner pinion bearing cup using the **J 29609** (7.6 inch axle) or the **J 45870** (8.6 inch axle) (1), and the **J 8092** (2).
3. Determine the selective shim thickness for the pinion. Refer to **Pinion Depth Adjustment**.

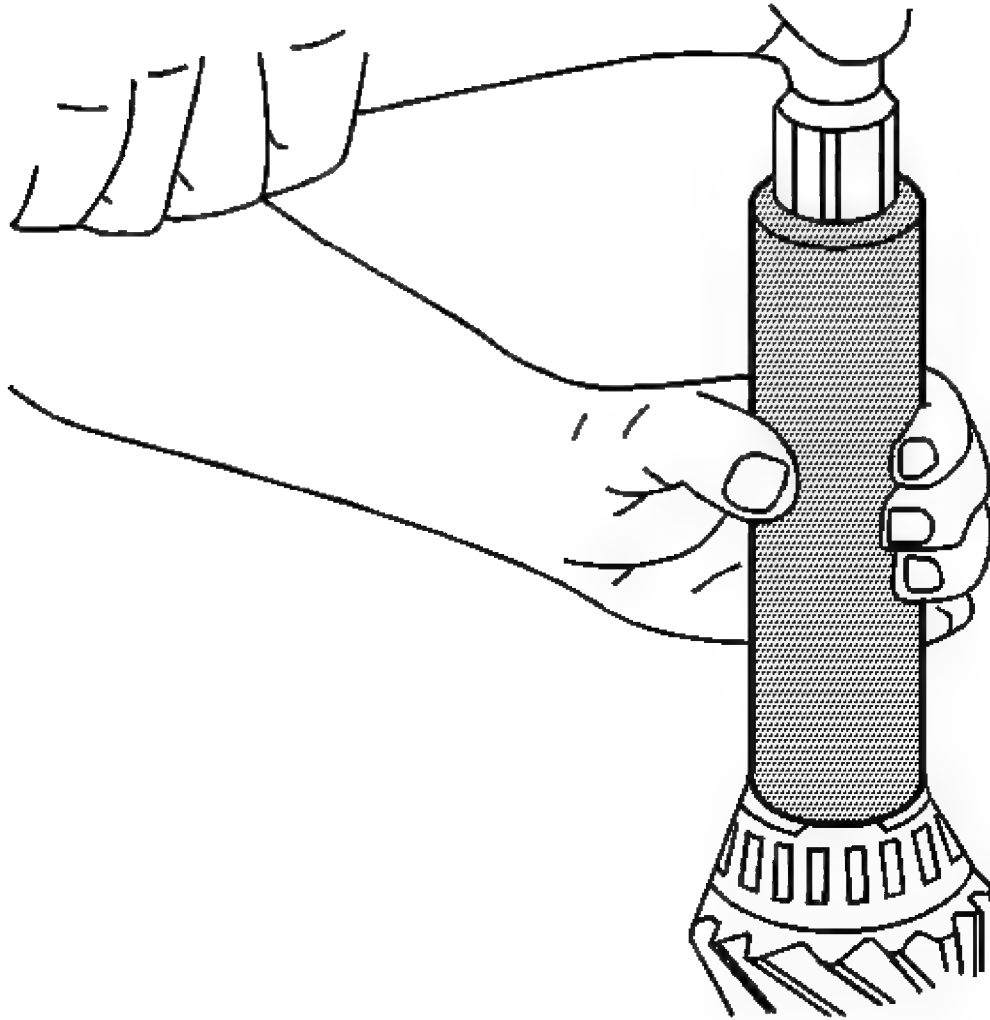


Fig. 68: Installing Inner Pinion Bearing Onto Pinion Gear
Courtesy of GENERAL MOTORS CORP.

4. Install the selective shim between the inner pinion bearing and the shoulder on the gear.
5. Install the inner pinion bearing using the **J 5590** (7.6 inch axle) or the **J 24433** (8.6 inch axles).

Press the bearing on until the cone seats on the pinion shim.

6. Install a new collapsible spacer.
7. Lubricate the pinion bearing with axle lubricant. Use the proper fluid. Refer to **Fluid and Lubricant Recommendations** in Maintenance and Lubrication.

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8. Install the pinion into the axle housing.
9. Install the outer pinion bearing onto the pinion.
10. Install a new pinion oil seal and the pinion flange/yoke. Refer to **Drive Pinion Flange/Yoke and/or Oil Seal Replacement**.
11. Install the differential assembly. Refer to **Differential Replacement**.
12. Install the brake rotors. Refer to **Brake Rotor Replacement - Rear** in Disc Brakes.
13. Install the brake calipers. Refer to **Brake Caliper Replacement - Rear** in Disc Brakes.
14. Install the tire and wheel assemblies. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels.
15. Fill the axle with lubricant. Use the proper fluid. Refer to **Capacities - Approximate Fluid** and **Fluid and Lubricant Recommendations** in Maintenance and Lubrication.
16. Lower the vehicle.

DIFFERENTIAL REPLACEMENT

Removal Procedure

IMPORTANT: Group and mark the shims together as originally removed. If you remove or replace the ring and pinion gearset, perform the bearing preload, backlash, and gear tooth contact pattern check in order to ensure proper contact of the gears. If you reinstall or replace the differential carrier without replacing any other component (i.e. pinion and ring gear set, bearings, etc.) then you may reinstall the carrier with the original shims in their original locations. Always perform a gear tooth contact pattern check, even when you remove only the carrier.

1. Raise the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
2. Remove the tires and wheel assemblies. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels.
3. Remove the brake calipers. Refer to **Brake Caliper Replacement - Rear** in Disc Brakes.
4. Remove the brake rotors. Refer to **Brake Rotor Replacement - Rear** in Disc Brakes.
5. Remove the rear axle housing cover and the gasket. Refer to **Rear Axle Housing Cover and Gasket Replacement**.
6. Remove the axle shafts. Refer to **Rear Axle Shaft Replacement**.

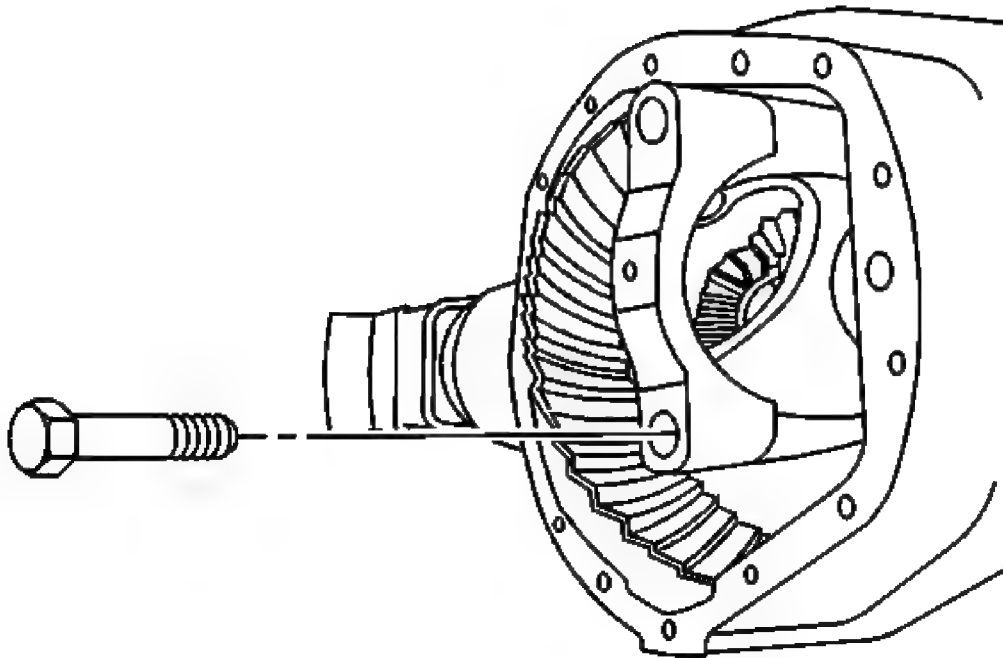


Fig. 69: Removing/Installing Bearing Cap Bolt
Courtesy of GENERAL MOTORS CORP.

7. Remove the bearing caps and bolts. Mark the bearing caps left and right.

CAUTION: To prevent personal injury and/or component damage, support the differential case when removing the case from the axle housing. If the case is not supported, the differential case could fall and cause personal injury or damage to the differential case.

NOTE: When removing the differential case from the axle housing, do not damage the cover gasket surface. If the cover gasket surface is damaged, lubricant may leak from the axle and cause premature failure of the axle assembly.

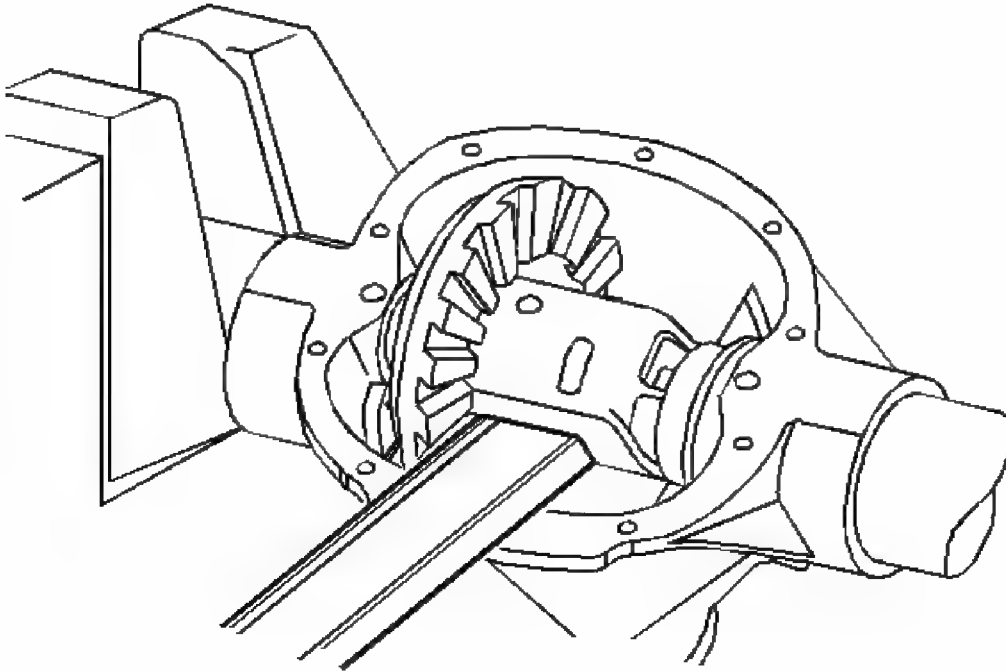


Fig. 70: Removing Differential
Courtesy of GENERAL MOTORS CORP.

8. Remove the differential by prying the differential from the axle housing at the differential window.
9. Remove the differential assembly.
10. Remove the bearing cups, the shims, and the spacers as necessary.

Mark the cups and shims left and right and in the proper order as necessary. Place the cups and the shims with the bearing caps.

11. Remove the differential side bearings, if necessary. Refer to **Differential Side Bearings Replacement**.
12. Remove the ring gear, if necessary. Refer to **Drive Pinion and Ring Gear Replacement**.

Installation Procedure

1. Install the ring gear, if necessary. Refer to **Drive Pinion and Ring Gear Replacement**.
2. Install the differential side bearings, if necessary. Refer to **Differential Side Bearings Replacement**.

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3. Lubricate the differential side bearings with axle lubricant. Use the proper fluid. Refer to **Fluid and Lubricant Recommendations** in Maintenance and Lubrication.

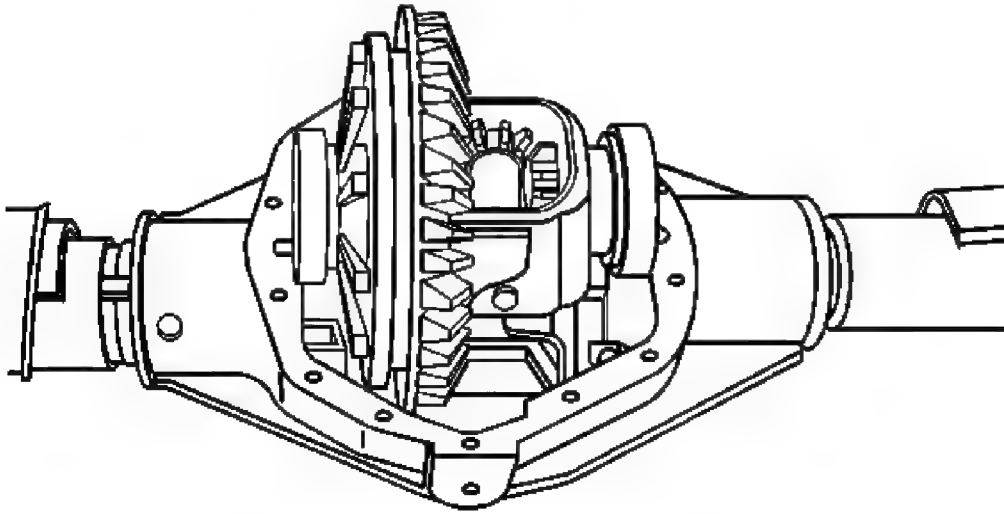


Fig. 71: View Of Differential Case And Axle Housing
Courtesy of GENERAL MOTORS CORP.

4. Place the case, with the bearing cups installed, into the axle housing.

Support the case in order to keep the case from falling out of the axle housing.

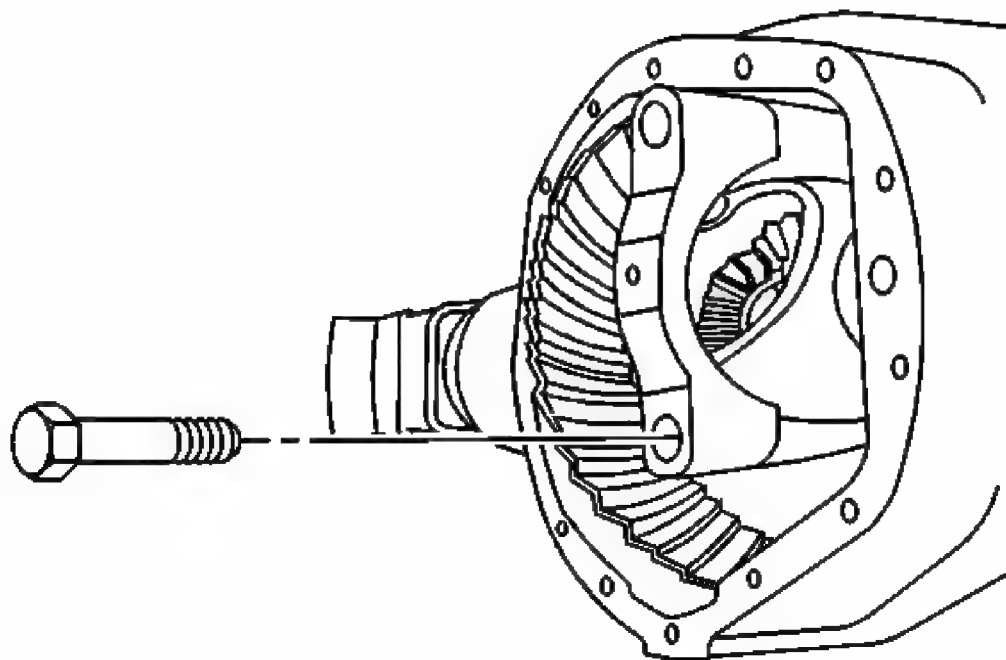


Fig. 72: Removing/Installing Bearing Cap Bolt
Courtesy of GENERAL MOTORS CORP.

5. Install the bearing caps and the bolts.

Do not torque the bearing cap bolts at this time.

6. Adjust the differential side bearing preload. Refer to **Differential Side Bearing Preload Adjustment**.
7. Adjust the backlash. Refer to **Backlash Adjustment (7.6, 8.6 Inch Axle)**.
8. Perform a gear tooth contact pattern check. Refer to **Gear Tooth Contact Pattern Inspection**.

NOTE: Refer to **Fastener Notice** in Cautions and Notices.

9. Tighten the bearing cap bolts.

Tighten: Tighten the bearing cap bolts to 75 N.m (55 lb ft).

10. Install the axle shafts. Refer to **Rear Axle Shaft Replacement**.
11. Install the rear axle housing cover and a new gasket. Refer to **Rear Axle Housing**

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Cover and Gasket Replacement.

12. Install the brake rotors. Refer to **Brake Rotor Replacement - Rear** in Disc Brakes.
13. Install the brake calipers. Refer to **Brake Caliper Replacement - Rear** in Disc Brakes.
14. Install the tire and wheel assemblies. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels.
15. Fill the axle with lubricant. Use the proper fluid. Refer to **Capacities - Approximate Fluid** and **Fluid and Lubricant Recommendations** in Maintenance and Lubrication.
16. Lower the vehicle.

DIFFERENTIAL SIDE BEARINGS REPLACEMENT

Tools Required

- **J 8092** Universal Driver Handle - 3/4 in - 10
- **J 21784** Side Bearing Installer. See **Special Tools and Equipment**.
- **J 22888-D** Side Bearing Remover Kit. See **Special Tools and Equipment**.
- **J 22912-01** Split-Plate Bearing Puller
- **J 25299** Side Bearing Installer. See **Special Tools and Equipment**.

Removal Procedure

1. Remove the differential assembly. Refer to **Differential Replacement**.

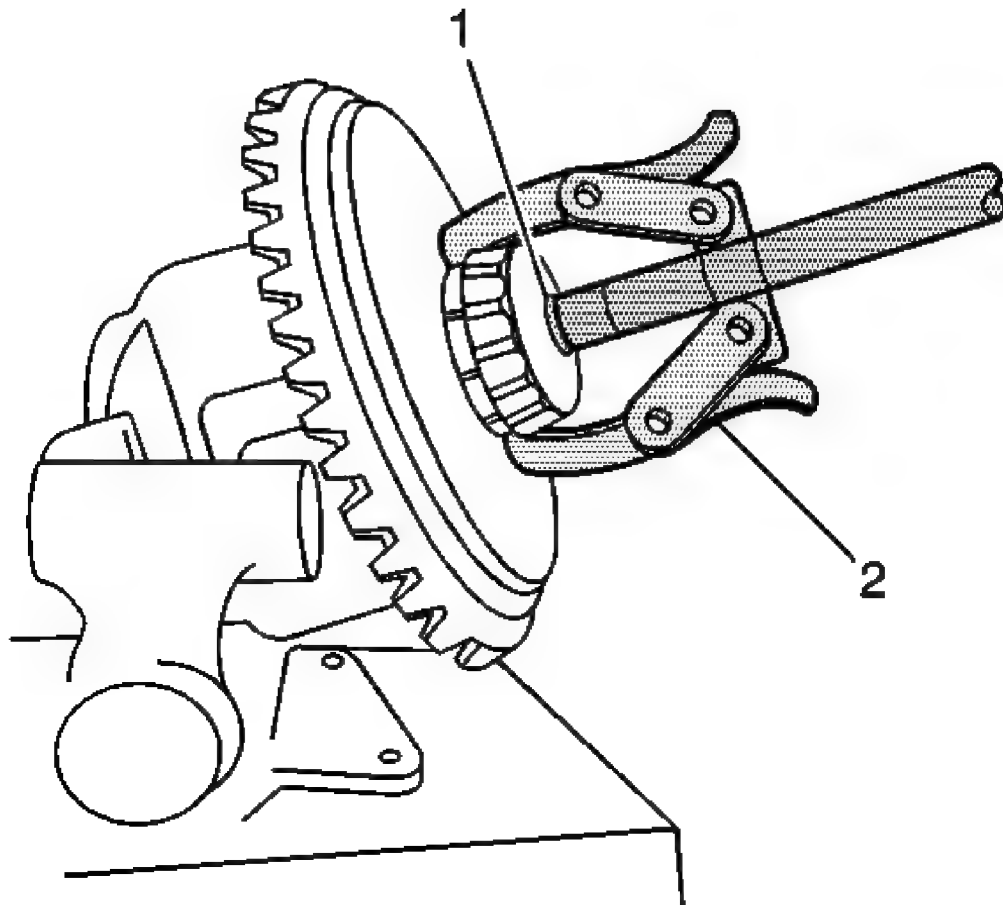


Fig. 73: Removing Differential Side Bearing
Courtesy of GENERAL MOTORS CORP.

2. Remove the differential side bearings by doing the following:
 - A. Install the differential assembly into a vise.
 - B. Install the **J 8107-2** (7.6 inch axle) or the **J 8107-4** (8.6 inch axle) (1) **J 22888-20A** (2) onto the differential case.
 - C. Remove the differential side bearings using the **J 22888-20A** .
3. Remove the differential assembly from the vise.

Installation Procedure

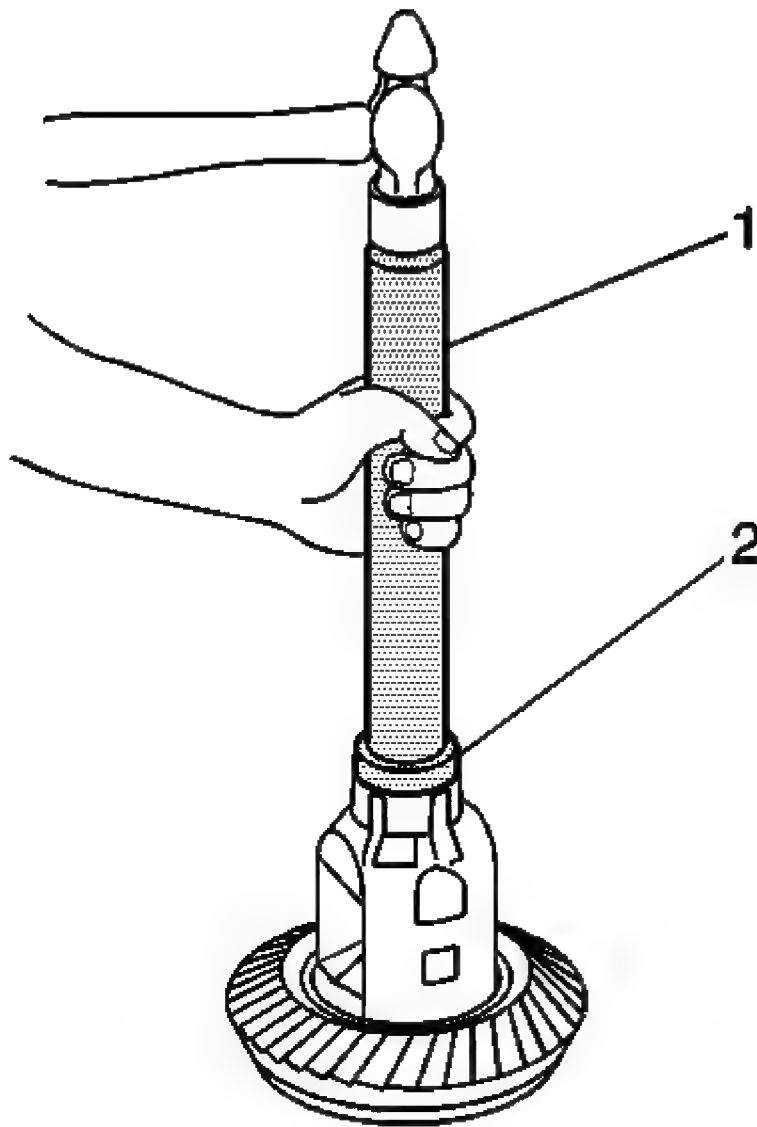


Fig. 74: Driving The Differential Side Bearing Into Position
Courtesy of GENERAL MOTORS CORP.

1. Install the differential side bearings by doing the following:
 - A. In order to protect the differential case, install the **J 8107-2** or the **J 8107-4** in the case on the side opposite the bearing installation.
 - B. Install the **J 25299** (7.6 inch axle) or the **J 21784** (8.6 inch axle) (2) and the **J 8092** (1) onto the differential case bearing as shown.
 - C. Drive the bearing onto the case using the **J 25299** or the **J 21784** (2) and the **J**

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8092 (1).

2. Install the differential assembly. Refer to **Differential Replacement**.

REAR AXLE REPLACEMENT

Removal Procedure

1. Raise the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
2. Support the rear axle housing in order to relieve tension on the leaf springs.
3. Remove the rear tires and wheels assembly. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels.
4. Remove the rear brake rotors. Refer to **Brake Rotor Replacement - Rear** in Disc Brakes.
5. Remove the rear brake hose mounting bracket bolt at the axle housing. Refer to **Brake Hose Replacement - Rear** in Hydraulic Brakes.
6. Remove the rear park brake cables. Refer to **Park Brake Actuator Replacement** in Park Brake.
7. Remove right rear park brake cable from the cable guide on the rear axle.
8. Disconnect the lower mount of the shock absorber. Refer to **Shock Absorber Replacement** in Rear Suspension.

IMPORTANT: Do not remove propeller shaft from the slip yoke.

9. Remove the propeller shaft attached to the rear drive axle. Refer to the appropriate procedure in Propeller Shaft:
 - **Propeller Shaft Replacement - One Piece**
 - **Propeller Shaft Replacement - Two Piece**
10. Secure the propeller shaft out of the way in order not put stress on the universal joints.
11. Remove the rear leaf springs. Refer to **Leaf Spring Replacement** in Rear Suspension.

IMPORTANT: Do not remove vent hose attached to frame.

12. Disconnect the vent hose from the rear axle housing.
13. Lower the axle from the vehicle.

Installation Procedure

1. Raise the rear drive axle to a height in order to install the rear leaf springs.
2. Install the rear leaf springs. Refer to **Leaf Spring Replacement** in Rear Suspension.

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3. Connect the vent hose to the axle housing.
4. Line up the previously made marks on the propeller shaft with the marks on the pinion flange.
5. Install the propeller shaft. Refer to the appropriate procedure in Propeller Shaft:
 - **Propeller Shaft Replacement - One Piece**
 - **Propeller Shaft Replacement - Two Piece**
6. Install the right rear park brake cable in the cable guide on the rear axle.
7. Connect the park brake cables. Refer to **Park Brake Actuator Replacement** in Park Brake.
8. Install the rear brake rotors. Refer to **Brake Pads Replacement - Rear** in Disc Brakes.
9. Install the rear tires and wheels assembly. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels.
10. Fill the axle with axle lubricant. Use the proper fluid. Refer to **Capacities - Approximate Fluid** and **Fluid and Lubricant Recommendations** in Maintenance and Lubrication.
11. Bleed the brakes system. Refer to **Hydraulic Brake System Bleeding (Manual)** or **Hydraulic Brake System Bleeding (Pressure)** in Hydraulic Brakes.
12. Lower the vehicle.
13. Test drive vehicle and check for leaks.

REAR AXLE HOUSING REPLACEMENT

Removal Procedure

1. Raise the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
2. Place jack or utility stands (such as GMDE 123-B67313) at the front of the vehicle.
3. Support the rear axle housing in order to relieve tension on the leaf springs.
4. Remove the rear tires and wheels assemblies. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels.
5. Disconnect the shock absorbers from the axle brackets. Refer to **Shock Absorber Replacement** in Rear Suspension.
6. Disconnect the vent hose from the rear axle housing.

IMPORTANT: Do not remove propeller shaft from the transmission or transfer case.

7. Disconnect the propeller shaft attached to the rear drive axle. Refer to the appropriate procedure in Propeller Shaft:
 - **Propeller Shaft Replacement - One Piece**
 - **Propeller Shaft Replacement - Two Piece**

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8. Secure the propeller shaft out of the way in order not put stress on the universal joints.
9. Remove the rear axle housing cover and gasket. Refer to **Rear Axle Housing Cover and Gasket Replacement**.
10. Disconnect the brake caliper hose from the brake pipe. Refer to **Brake Hose Replacement - Rear** in Hydraulic Brakes.
11. Remove the brake calipers. Refer to **Brake Caliper Replacement - Rear** in Disc Brakes.
12. Remove the brake rotors. Refer to **Brake Rotor Replacement - Rear** in Disc Brakes.
13. Remove the backing plates. Refer to **Disc Brake Backing Plate Replacement - Rear** in Disc Brakes.
14. Remove the brake pipe from the axle housing.
15. Remove the rear park brake cables. Refer to **Park Brake Actuator Replacement** in Park Brake.
16. Remove right rear park brake cable from the cable guide on the rear axle.
17. Disconnect the rear spring from the axle. Refer to **Leaf Spring Replacement** in Rear Suspension.
18. Lower the axle from the vehicle.
19. Remove the differential assembly. Refer to **Differential Replacement**.
20. Remove the drive pinion yoke. Refer to **Drive Pinion Flange/Yoke and/or Oil Seal Replacement**.
21. Remove the drive pinion. Refer to **Drive Pinion and Ring Gear Replacement**.
22. Remove the drive pinion bearings from the drive pinion. Refer to **Drive Pinion Bearings Replacement**.
23. Remove the differential side bearings. Refer to **Differential Side Bearings Replacement**.

Installation Procedure

1. Install the new differential side bearings to the differential assembly. Refer to **Differential Side Bearings Replacement**.
2. Determine the selective shim thickness for the drive pinion. Refer to **Pinion Depth Adjustment**.
3. Install the new drive pinion bearings. Refer to **Drive Pinion Bearings Replacement**.
4. Install the drive pinion. Refer to **Drive Pinion and Ring Gear Replacement**.
5. Install the new drive pinion yoke oil seal and drive pinion yoke. Refer to **Drive Pinion Flange/Yoke and/or Oil Seal Replacement**.
6. Install the differential assembly. Refer to **Differential Replacement**.
7. Install the new rear axle shaft bearings and oil seals. Refer to **Rear Axle Shaft Seal and/or Bearing Replacement**.

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8. Install the axle housing assembly to the rear springs. Refer to **Leaf Spring Replacement** in Rear Suspension.
9. Install the brake pipe to the axle housing.
10. Install the backing plates. Refer to **Disc Brake Backing Plate Replacement - Rear** in Disc Brakes.
11. Install the brake rotors. Refer to **Brake Rotor Replacement - Rear** in Disc Brakes.
12. Install the brake calipers. Refer to **Brake Caliper Replacement - Rear** in Disc Brakes.
13. Connect the brake caliper hose to the brake pipe. Refer to **Brake Hose Replacement - Rear** in Hydraulic Brakes.
14. Install the rear axle housing cover and new gasket. Refer to **Rear Axle Housing Cover and Gasket Replacement**.
15. Install the right rear park brake cable in the cable guide on the rear axle.
16. Connect the park brake cables. Refer to **Park Brake Actuator Replacement** in Park Brake.
17. Install the propeller shaft. Refer to the appropriate procedure in Propeller Shaft:
 - **Propeller Shaft Replacement - One Piece**
 - **Propeller Shaft Replacement - Two Piece**
18. Connect the shock absorbers to the axle brackets. Refer to **Shock Absorber Replacement** in Rear Suspension.
19. Connect the vent hose to the axle housing.
20. Install the rear tires and wheels assemblies. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels.
21. Fill the axle with lubricant. Use the proper fluid. Refer to **Lubricant Replacement - Rear Drive Axle**.
22. Bleed the brakes system, disc brake systems only. Refer to **Hydraulic Brake System Bleeding (Manual)** or **Hydraulic Brake System Bleeding (Pressure)** in Hydraulic Brakes.
23. Remove the safety stands.
24. Lower the vehicle.
25. Test drive vehicle and check for leaks.

DIFFERENTIAL OVERHAUL

Tools Required

- **J 8092** Universal Driver Handle - 3/4 in - 10
- **J 21784** Side Bearing Installer. See **Special Tools and Equipment**.
- **J 22888-D** Side Bearing Remover Kit. See **Special Tools and Equipment**.
- **J 22912-01** Split-Plate Bearing Puller

- **J 25299** Side Bearing Installer. See Special Tools and Equipment.

Disassembly Procedure

1. Remove the differential side bearings, if necessary. Refer to Differential Side Bearings Replacement.

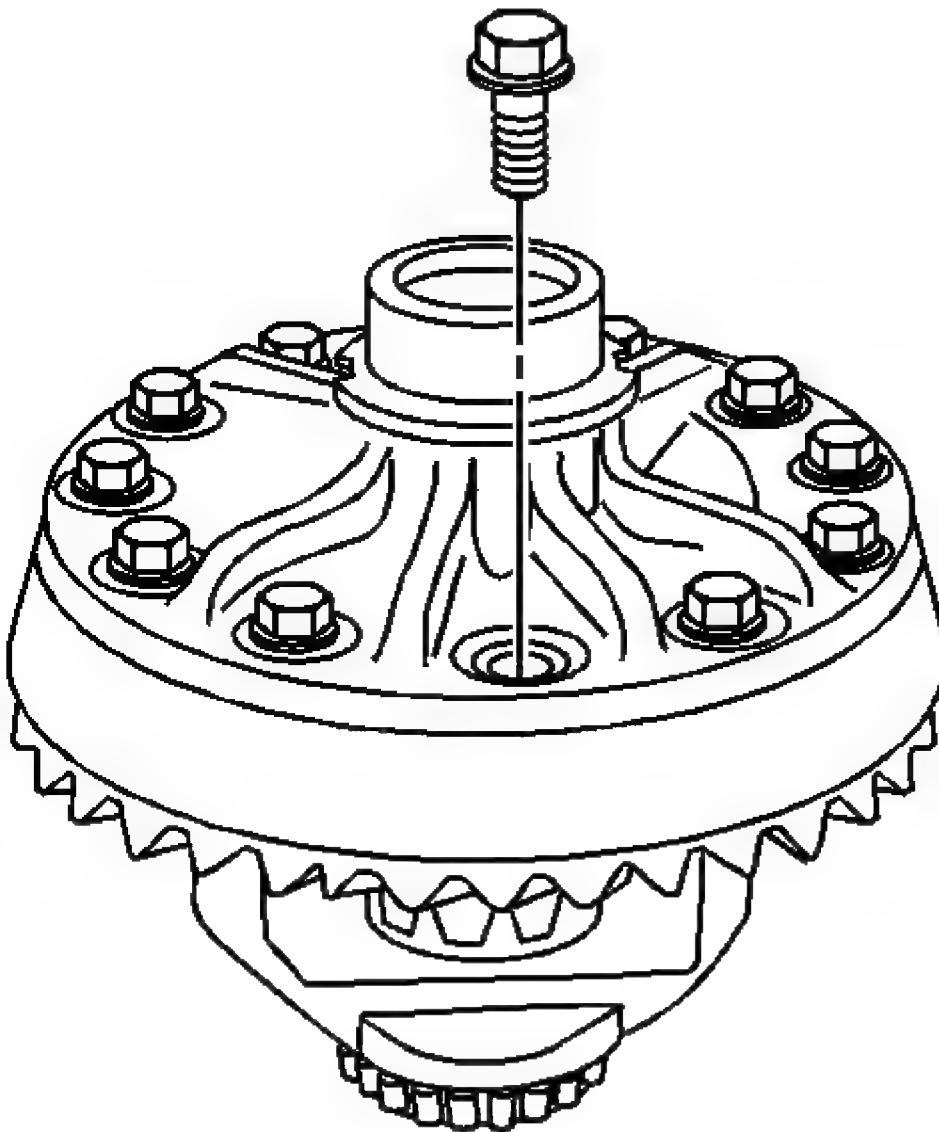


Fig. 75: Identifying Ring Gear Bolts
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: The ring gear bolts have left-hand threads.

2. Remove the ring gear bolts. Discard the bolts.

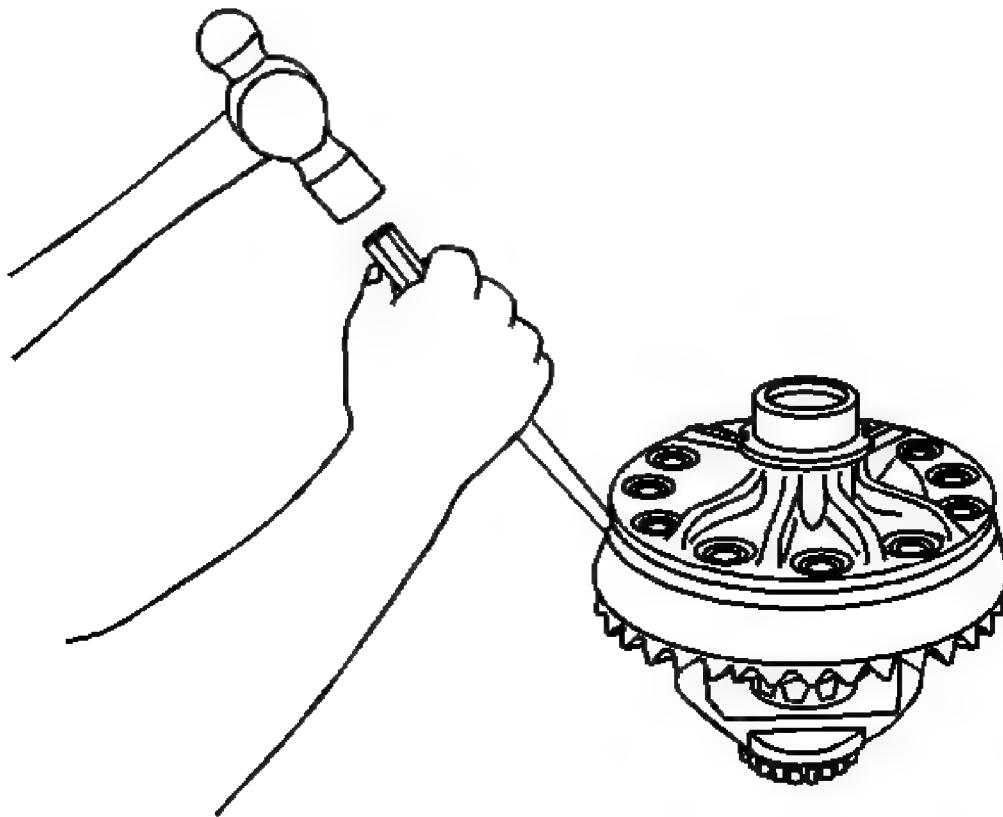


Fig. 76: Removing Ring Gear From Differential
Courtesy of GENERAL MOTORS CORP.

NOTE: Do not pry the ring gear from the differential case. Prying the ring gear from the differential case may cause damage to the ring gear and/or the differential case.

3. Remove the ring gear from the differential case.

Drive the ring gear off with a brass drift, if necessary.

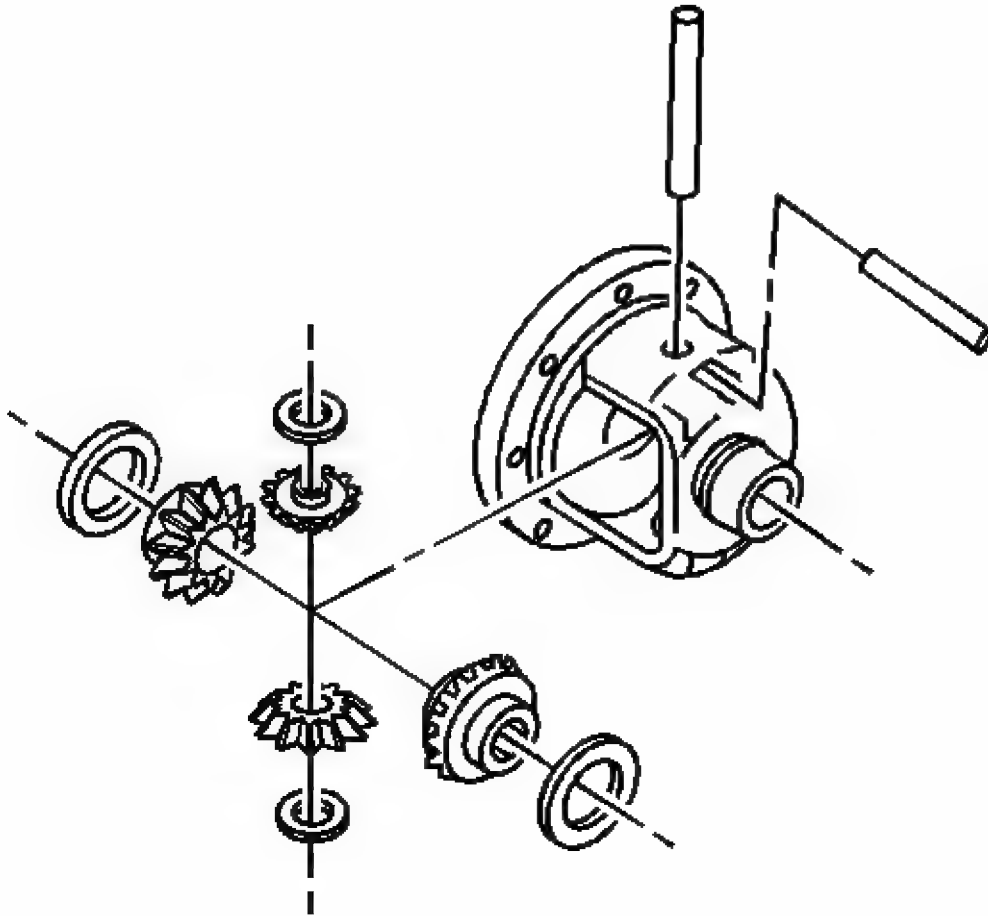


Fig. 77: Exploded View Of Differential Case
Courtesy of GENERAL MOTORS CORP.

4. Remove the differential pinion gears and the differential side gears by doing the following:
 - A. Remove the pinion shaft lock bolt.
 - B. Remove the pinion shaft.
 - C. Roll the differential pinion gear out of the case with the pinion thrust washers.
 - D. Remove the differential side gears and the side gear thrust washers.

Mark the pinion gears top and bottom and the differential side gears left and right.

Assembly Procedure

1. Lubricate the pinion and side gears with axle lubricant. Use the proper fluid. Refer to

Fluid and Lubricant Recommendations in Maintenance and Lubrication.

2. Install the thrust washers to the differential side gears.

If the same differential side gears and the thrust washers are being used, install the gears and the thrust washers to the original locations.

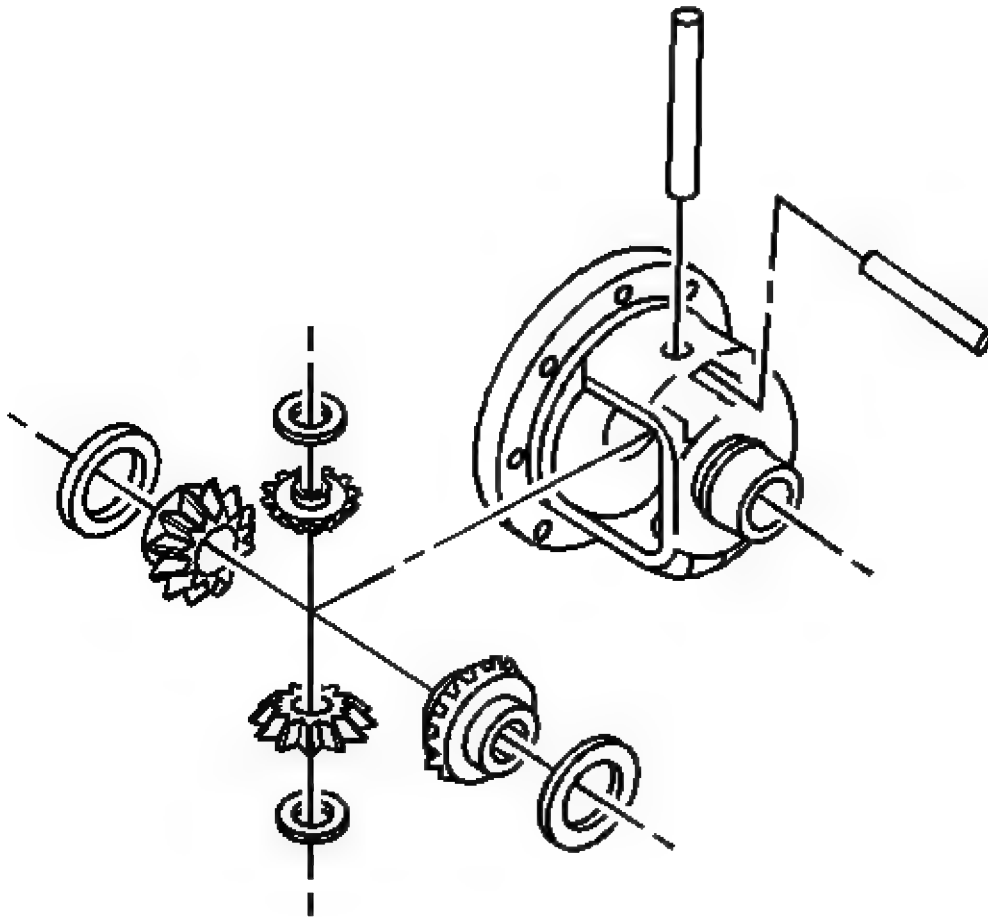


Fig. 78: Exploded View Of Differential Case
Courtesy of GENERAL MOTORS CORP.

3. Install the differential pinion gears by doing the following:
 - A. Position one pinion gear between the differential side gears.
 - B. Rotate the differential side gears until the pinion gear is directly opposite the opening in the differential case.
 - C. Place the other pinion gear between the differential side gears.

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Line up the hole in both the pinion gears.

4. Rotate the pinion gears toward the opening in order to permit the sliding in of the thrust washers. Install the thrust washers.
5. Install the pinion shaft.

NOTE: Refer to Fastener Notice in Cautions and Notices.

6. Install a new pinion shaft lock bolt.

Tighten: Tighten the new pinion shaft lock bolt to 25 N.m (18 lb ft).

IMPORTANT: The mating surface of the ring gear and the differential case must be clean and free of burrs before installing the ring gear.

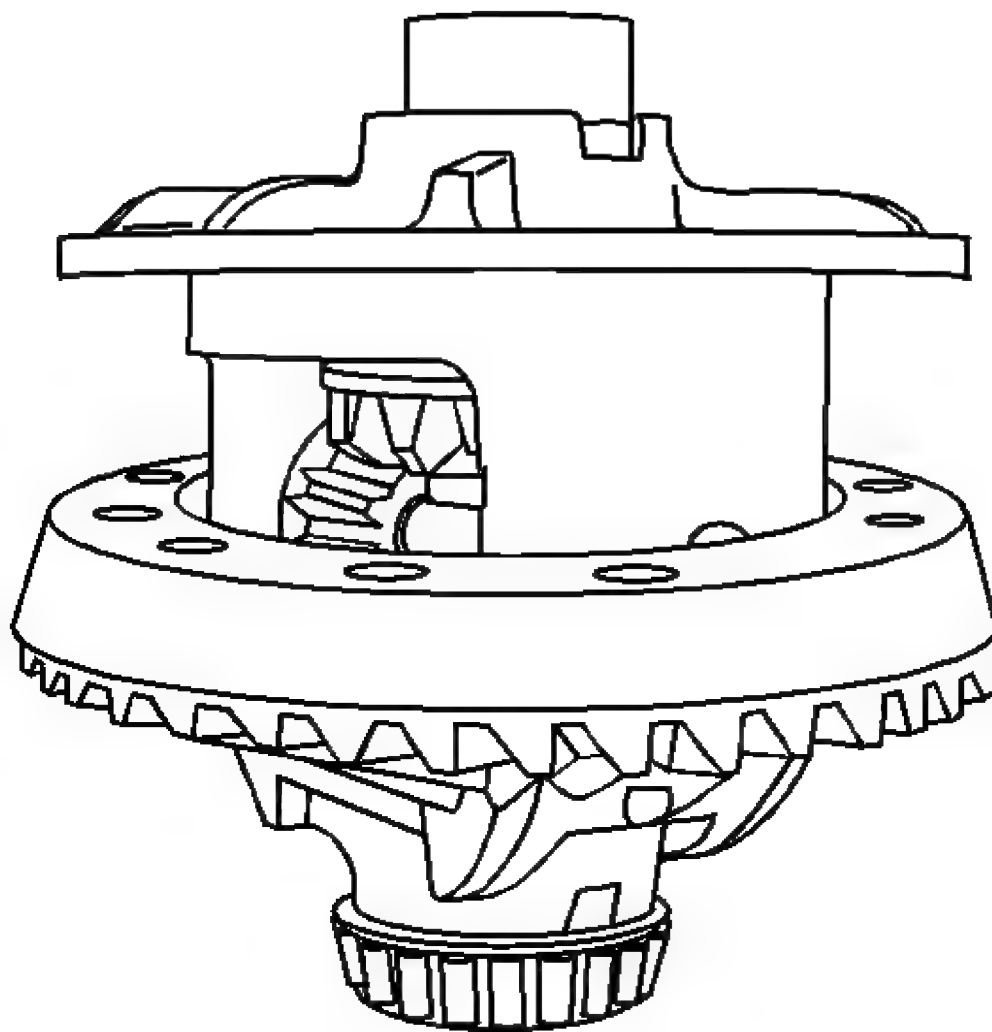


Fig. 79: Ring Gear & Differential Case
Courtesy of GENERAL MOTORS CORP.

7. Install the ring gear onto the differential case.

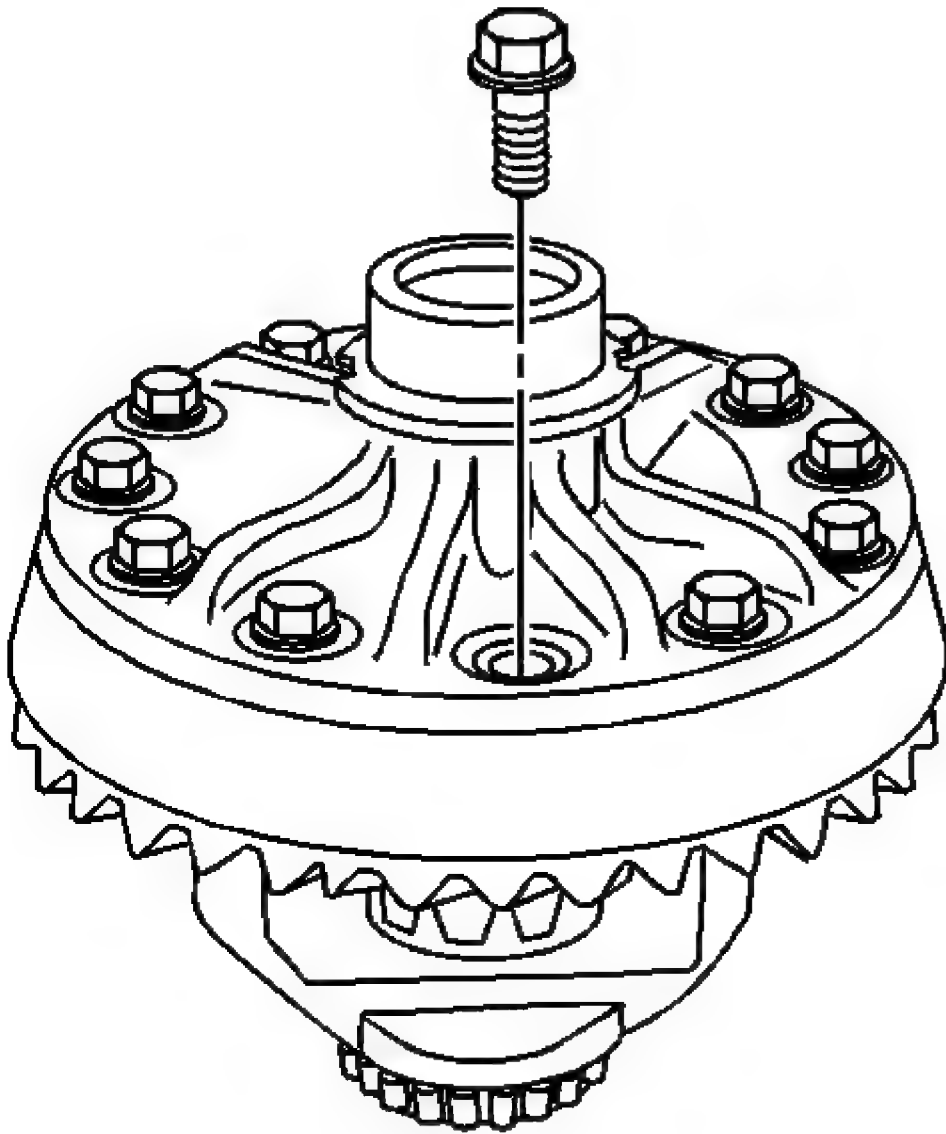


Fig. 80: Identifying Ring Gear Bolts
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: The ring gear bolts have left-hand threads.

8. Install the new ring gear bolts.

Hand start each bolt to ensure that the ring gear is properly installed to the differential

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case.

9. Tighten the ring gear bolts. Tighten the ring gear bolts alternately and in stages, gradually pulling the ring gear onto the differential case.

Tighten: Tighten the ring gear bolts in sequence to 120 N.m (89 lb ft).

10. Install the differential side bearings, if necessary. Refer to **Differential Side Bearings Replacement**.

BEARINGS INSPECTION

Carefully and thoroughly inspect all drive unit parts before assembly. Thorough inspection of the drive parts for wear or stress with subsequent replacement of worn parts eliminates costly drive component repair after assembly.

IMPORTANT: The differential bearings and the bearing cups are matched sets. Replace both the bearing and the cup when either part requires replacement.

- Lubricate the bearings with axle lubricant. Inspect the bearings for smooth rotation.
- Inspect the bearing rollers for wear.
- Inspect the bearing cups for wear, cracks, brinelling, and scoring.

DIFFERENTIAL INSPECTION

- Check the pinion gear shaft for unusual wear.
- Check the pinion and the side gear teeth for wear, cracks, scoring and spalling.
- Check the thrust washers for wear.
- Check the fit of the side gears in the differential case and on the axle shafts.
- Check the differential case for cracks and scoring and replace all of the worn parts as necessary.

PINION AND RING GEAR INSPECTION

Ring and pinion gears are matched sets. When replacement of one or the other is necessary, both the ring and pinion gear must be replaced.

- Check the pinion and ring gear teeth for cracking, chipping, scoring, or excessive wear.
- Check the pinion gear splines for wear.
- Check the pinion flange/yoke splines for wear.
- Check the fit of the pinion gear splines on the pinion flange/yoke.
- Check the sealing surface of the pinion flange/yoke for nicks, burrs or rough tool marks

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that could damage the seal and cause an oil leak.

- Check for worn or broken parts and replace as necessary.

REAR AXLE HOUSING INSPECTION

Carefully and thoroughly inspect all drive unit parts before assembly. Thorough inspection of the drive parts for wear or stress with subsequent replacement of worn parts eliminates costly drive component repair after assembly.

- Inspect for nicks or burrs that could prevent the outer diameter of the pinion seal from sealing. Remove any burrs.
- Inspect the bearing cup bores for nicks or burrs. Remove any burrs that are found.
- Inspect the housing for cracks. Replace the housing if any cracks are found.
- Inspect the housing for foreign material such as metal chips, dirt, or rust.

SHIMS INSPECTION

IMPORTANT:

- **Do not reinstall the original cast iron production shims, if removed. Once the cast iron shims are removed from the axle housing, they must be replaced with service shims and spacers.**
- **If service shims were previously installed, the shims can be reused.**

Inspect the shims for cracks and chips. Replace the damaged shims.

PINION DEPTH ADJUSTMENT

Tools Required

- J 8001 Dial Indicator Set
- J 21777-40 Rear Pilot Washer. See Special Tools and Equipment.
- J 21777-42 Front Pilot Washer. See Special Tools and Equipment.
- J 21777-43 Stud Assembly Bolt. See Special Tools and Equipment.
- J 21777-45 Side Bearing Discs. See Special Tools and Equipment.
- J 21777-1 Arbor
- J 21777-29 Gage Plate
- J 21777-35 Rear Pilot Washer
- J 23597-1 Arbor. See Special Tools and Equipment.
- J 23597-11 Gage Plate. See Special Tools and Equipment.

IMPORTANT: Make sure all of the tools, the differential side bearing bores, and the pinion bearing cups are clean before proceeding.

1. Lubricate the pinion bearings with axle lubricant. Refer to **Fluid and Lubricant Recommendations** in Maintenance and Lubrication.
2. Install the pinion bearings into the axle housing.

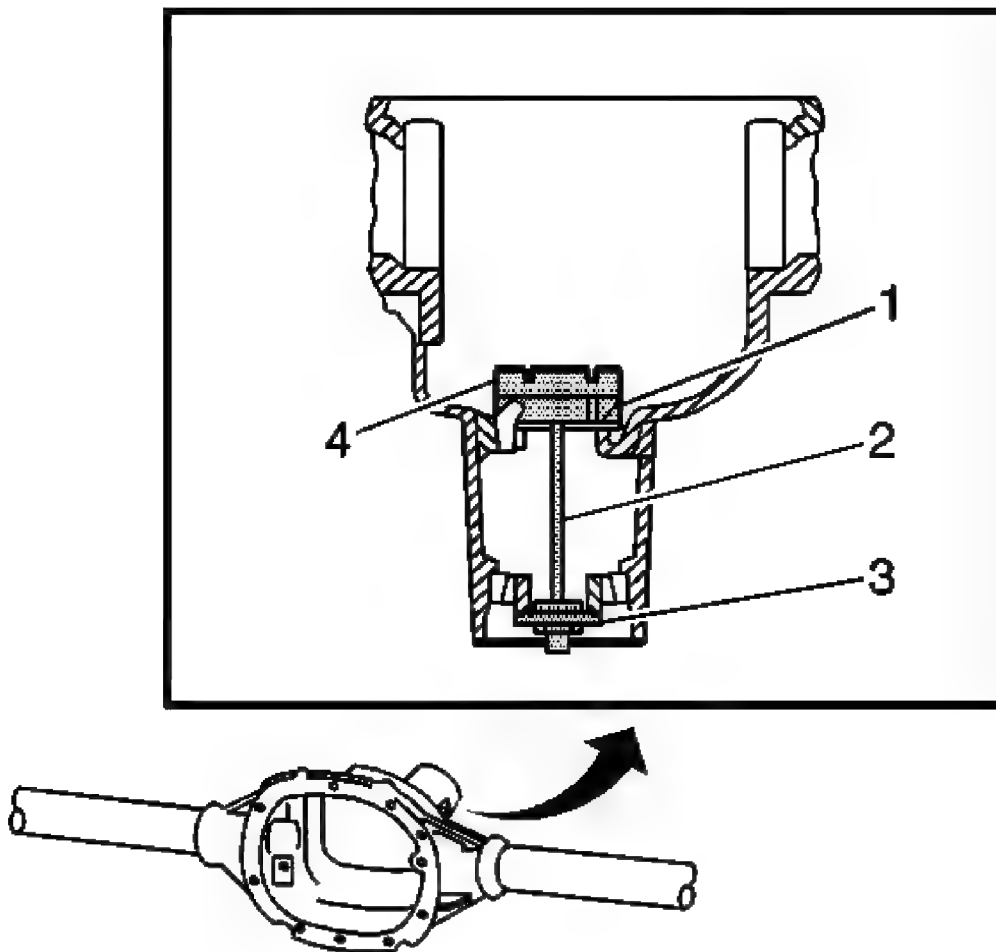


Fig. 81: Installed View Of J 21777-35, J 21777-43, J 21777-42, & J 45230
Courtesy of GENERAL MOTORS CORP.

3. Assemble the following components into the axle housing:
 - For the 7.6 inch axle, assemble the **J 21777-40** (1), the **J 21777-43** (2), the **J 21777-42** (3), and the **J 21777-45** (4) as shown.

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- For the 8.6 inch axle, assemble the **J 21777-35** (1), the **J 21777-43** (2), the **J 21777-42** (3), and the **J 21777-29** (4) as shown. See Special Tools and Equipment
4. While holding the **J 21777-43** stationary, install an inch-pound torque wrench on the nut of the **J 21777-43** and tighten the nut until a rotating torque of 2.2 N.m (20 lb in) is obtained.
- Rotate the assembly several times in both directions in order to seat the pinion bearings.
5. Check the rotating torque of the assembly. If the torque is less than 1.7 N.m (15 lb in), tighten the nut on the **J 21777-43** until a rotating torque of 1.7-2.8 N.m (15-25 lb in) is obtained.

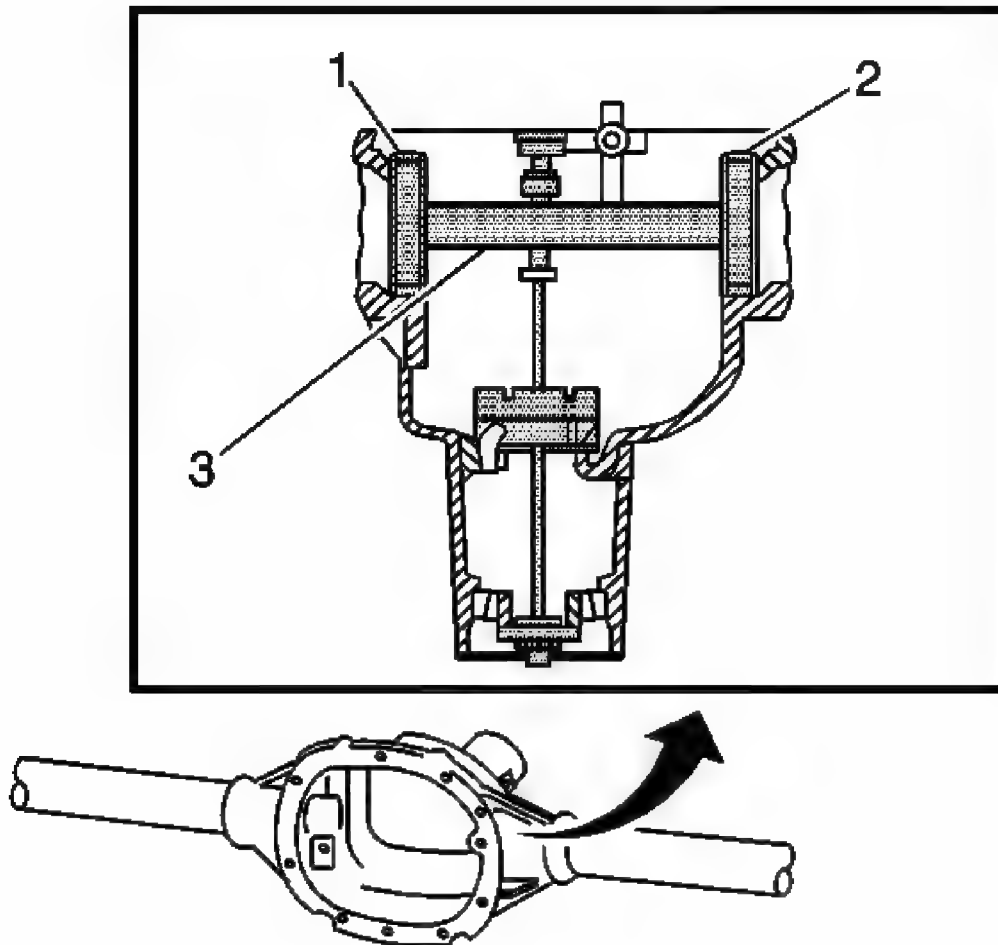


Fig. 82: Installed View Of J 21777-45 & J 21777-1
Courtesy of GENERAL MOTORS CORP.

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6. Assemble the following components into the differential carrier bore of the axle housing:
 - For the 7.6 inch axle, assemble the **J 21777-45** (1, 2) to the **J 23597-1** (3) as shown.
 - For the 8.6 inch axle, assemble the **J 21777-45** (1, 2) to the **J 21777-1** (3) as shown.
7. Install the bearing caps.

NOTE: **Refer to Fastener Notice in Cautions and Notices.**

8. Install the bearing cap bolts.

Tighten: Tighten the bearing cap bolts to 75 N.m (55 lb ft).

9. Rotate the **J 23597-1** (7.6 inch axle) or the **J 21777-1** (8.6 inch axle) within the **J 21777-45** . The **J 23597-1** or the **J 21777-1** must rotate back and forth freely within the discs. If the **J 23597-1** or the **J 21777-1** does not rotate freely, disassemble the components, inspect for proper seating and/or mis-aligned components and re-assemble.

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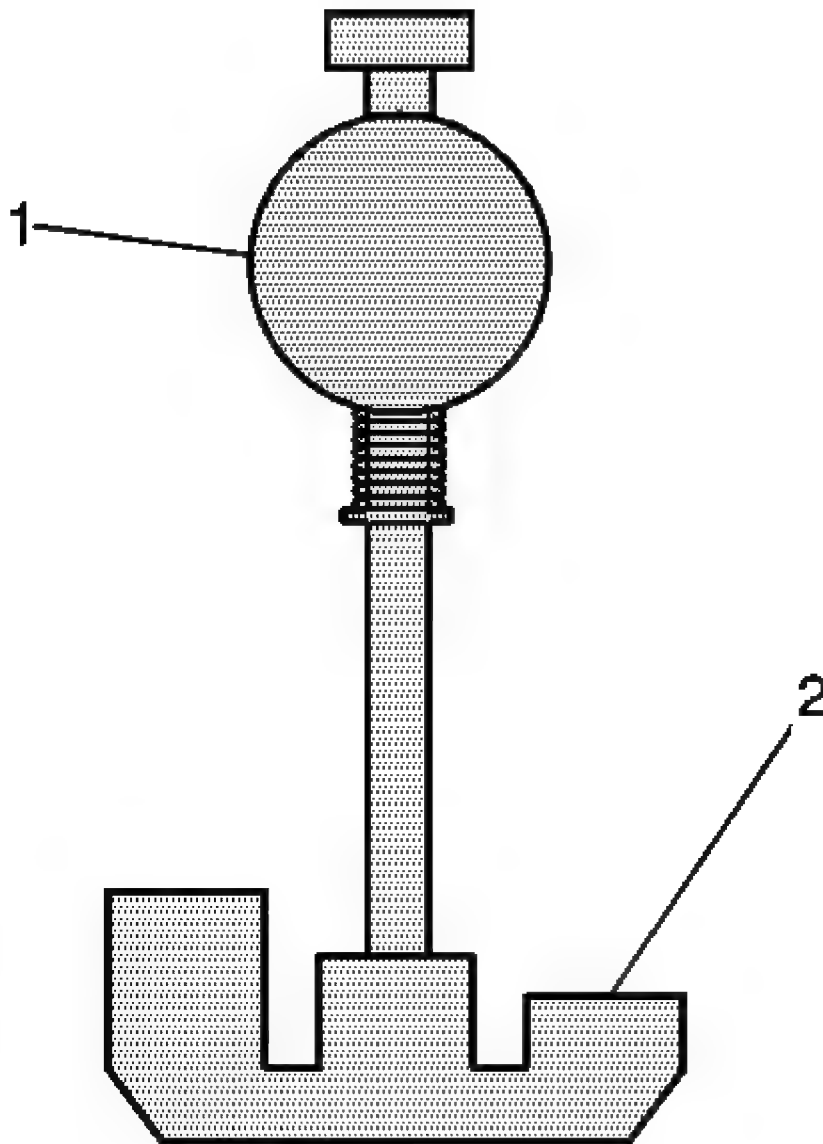


Fig. 83: View Of J 21777-1 & J 44416-3
Courtesy of GENERAL MOTORS CORP.

10. Align the plunger of the **J 23597-1** (1) to the **J 23597-11** (2) (7.6 inch axle) or the **J 21777-1** (1) to the **J 21777-29** (2) (8.6 inch axle).
11. Install the **J 8001** to the **J 23597-1** or the **J 21777-1** as follows:
 - A. Loosely clamp the **J 8001** onto the stem on the **J 23597-1** or the **J 21777-1** .
 - B. Place the contact pad of the **J 8001** onto the mounting post of the **J 23597-1** or the

J 21777-1 .

- C. With the contact pad of the **J 8001** touching the mounting post of the **J 23597-1** or the **J 21777-1** , loosen the lock nut on the **J 8001** and push down on the **J 8001** until the needle of the **J 8001** has turned 3/4 of a turn clockwise.
 - D. Tighten the clamp on the **J 8001** finger tight.
12. Move the plunger of the **J 23597-1** or the **J 21777-1** back and forth until the needle of the **J 8001** indicates the greatest deflection.

The deflection is the point where the needle changes direction.

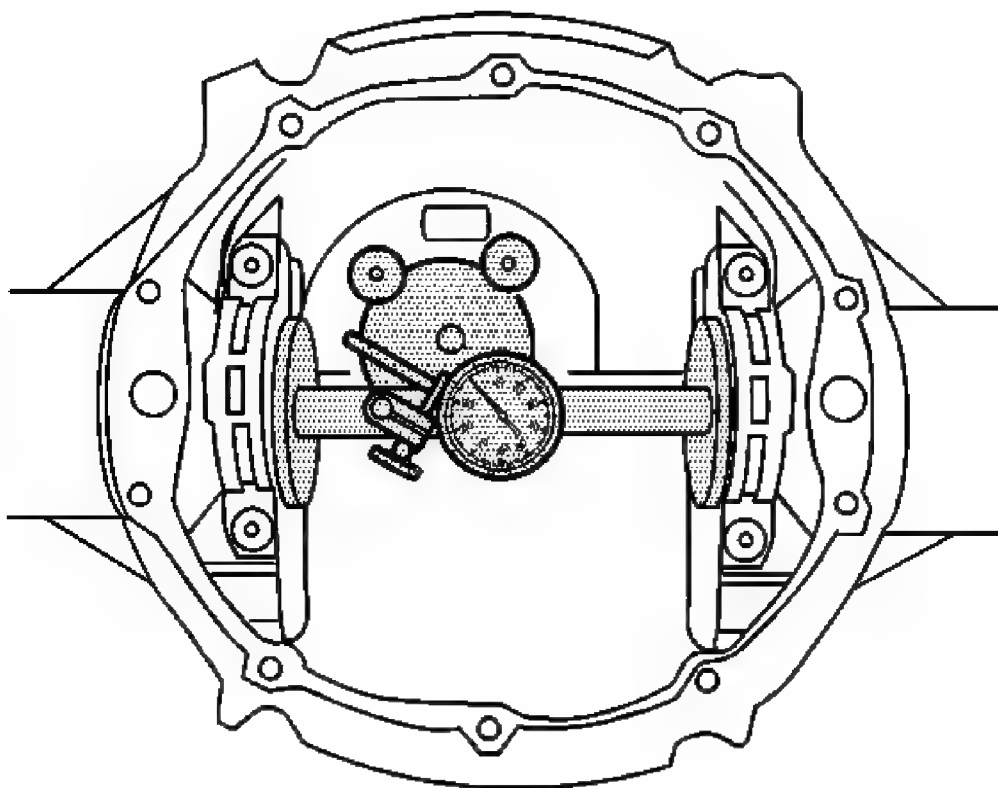


Fig. 84: Measuring Necessary Shim Thickness
Courtesy of GENERAL MOTORS CORP.

- 13. At the greatest point of deflection, move the housing of the **J 8001** until the needle indicates zero.
- 14. Move the plunger of the **J 23597-1** or the **J 21777-1** back and forth again to verify the zero setting. Adjust the housing of the **J 8001** as necessary to set the needle to zero.
- 15. Rotate the plunger of the **J 23597-1** from the **J 23597-11** (7.6 inch axle) or the **J**

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21777-1 away from the **J 21777-29** (8.6 inch axle) until it no longer touches the **J 23597-11** (7.6 inch axle) or the **J 21777-29** (8.6 inch axle).

16. The value indicated on the **J 8001** is the thickness of the shim needed in order to set the depth of the pinion.
17. Select the shim that indicates the proper thickness. Measure the shim with a micrometer in order to verify that the thickness is correct.
18. Remove the pinion depth setting tools.
19. Remove the pinion bearings.
20. Install the pinion shim between the pinion gear and the inner pinion bearing. Refer to **Drive Pinion Bearings Replacement**.

DIFFERENTIAL SIDE BEARING PRELOAD ADJUSTMENT

Tools Required

- **J 22779** Side Bearing Backlash Gage. See **Special Tools and Equipment**.
- **J 25588** Side Bearing Shim Installer. See **Special Tools and Equipment**.
- **J 25025** Guide Pins. See **Special Tools and Equipment**.
- **J 8001** Dial Indicator Set

IMPORTANT:

- **The differential side bearing preload adjustment must be completed before the backlash adjustment can be started.**
- **In order to maintain the original backlash, adjust the differential case side bearing preload by changing the thickness of the left and the right side shim packs equally.**
- **Measure the service shims and the spacers one at a time. Add the measurements together in order to obtain the total thickness of the left or the right side shim pack.**
- **Do not use or reuse the original cast iron production shims. Use service shims and spacers instead.**

1. Install the drive pinion, if necessary. Refer to **Drive Pinion and Ring Gear Replacement**.
2. Measure the rotating torque of the drive pinion using an inch-pound torque wrench.

Specification: The rotating torque of the drive pinion should be 1.7-3.4 N.m (15-30 lb in) for new bearings or 1.1-2.3 N.m (10-20 lb in) for used bearings.

Record the measurement.

IMPORTANT: Before installation of the differential assembly, ensure that

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the side bearing surfaces in the axle housing are clean and free of burrs. If the original bearings are to be reused, the original bearing cups must also be used.

3. Install the differential assembly with the side bearings and bearing cups into the axle housing.
4. Insert one 4.318 mm (0.170 in) thick service spacer into the left side of the axle housing.
5. Slide the differential assembly towards the service spacer in order to hold the spacer in place.
6. Install the **J 22779** between the right side differential side bearing cup and the axle housing.

IMPORTANT: Over-tightening may spread the housing and result in incorrect shim selection.

7. Tighten the knob on the **J 22779** until there is moderate drag when the **J 22779** is moved.
8. Remove the **J 22779**.
9. Remove the service spacer.
10. Using a micrometer, measure the thickness of the **J 22779** in 3 locations.
11. Calculate the average of the 3 measurements.

Record the measurement.

12. Using a micrometer, measure the thickness of the service spacer.

Record the measurement.

13. Add the thickness of the service spacer to the average thickness of the **J 22779**.

The resulting value is the total service shim thickness without preload for the axle.

14. Insert one 1.016 mm (0.040 in) service shim between the right side differential side bearing cup and the axle housing.
15. Insert one BENT 1.016 mm (0.040 in) service shim between the right side differential side bearing cup and the service shim.
16. Install the **J 22779** on the left side of the differential assembly.
17. While rotating the ring gear back and forth, tighten the knob on the **J 22779** until there is approximately 0.025-0.051 mm (0.001-0.002 in) of backlash between the ring gear and the drive pinion.
18. Once the amount of backlash is obtained, remove the **J 22779**.

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19. Remove the differential case with the differential side bearings and the bearing cups.
20. Remove the service shims.
21. Using a micrometer, measure the thickness of the **J 22779** in 3 locations.
22. Calculate the average of the 3 measurements.

This value is the left side service shim thickness without preload.

23. Subtract the service shim thickness for the left side of the axle, calculated in step 22, from the total service shim thickness, calculated in step 13.

This value is the service shim thickness for the right side of the axle without preload.

24. In order to initially set the preload of the differential side bearings and the backlash to approximately 0.013-0.023 mm (0.005-0.009 in), take the value determined in step 23 and add 0.0203 mm (0.008 in) service shim thickness to this amount.
25. Assemble the left side shim pack using one 4.318 mm (0.170 in) service spacer and the appropriate amount of selective service shims equaling the thickness determined in step 22.

Measure the service spacer and the service shims separately.

Add the measurements together in order to determine the total shim pack thickness.

26. Assemble the right side shim pack using one 4.318 mm (0.170 in) service spacer and the appropriate amount of selective service shims equaling the thickness determined in step 24.

Measure the service spacer and the service shims separately.

Add the measurements together in order to determine the total shim pack thickness.

27. Install the differential assembly with the differential side bearings and the differential side bearing cups.
28. Install the left side service spacer between the axle housing and the differential assembly.
29. Install the left side selective service shim or shims.

The service shim or shims must be installed between the service spacer and the differential side bearing cup.

30. Install the right side service spacer between the axle housing and the differential assembly.
31. Install the right side selective service shim or shims using the **J 25588** , if necessary.

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The service shim or shims must be installed between the service spacer and the differential side bearing cup.

NOTE: Refer to Fastener Notice in Cautions and Notices.

32. Install the differential bearing caps and the bolts.

Tighten: Tighten the differential bearing cap bolts to 75 N.m (55 lb ft).

33. Measure the drive pinion and differential side bearing preload using an inch-pound torque wrench.

Rotate the pinion several times to ensure the differential side bearings have seated.

Specification: The rotating torque of the drive pinion and differential side bearings should be 3.9-6.2 N.m (30-55 lb in) for new bearings or 2.8-5.1 N.m (25-45 lb in) for used bearings.

Record the measurement.

34. Calculate the differential side bearing preload by subtracting the drive pinion preload, measured in Step 2, from the drive pinion and differential case bearing preload, measured in Step 33.

Multiply the value obtained by the axle ratio.

Specification: The differential case side bearing preload should be 1.7-4.0 N.m (15-35 lb in).

35. If the differential side bearing preload is not within specifications, add or subtract shim thickness equally from each shim pack as necessary in order to increase/decrease the side bearing preload.
36. Once the differential side bearing preload is correct, measure the backlash and adjust, if necessary. Refer to Backlash Adjustment (7.6, 8.6 Inch Axle).
37. Once the differential side bearing preload and backlash is correct, perform a gear tooth contact pattern check in order to ensure proper alignment between the ring and pinion gears. Refer to Gear Tooth Contact Pattern Inspection.

BACKLASH ADJUSTMENT (7.6, 8.6 INCH AXLE)

Tools Required

- J 8001 Dial Indicator Set
- J 25025 Guide Pins. See **Special Tools and Equipment**

- **J 25588** Side Bearing Shim Installer. See Special Tools and Equipment.

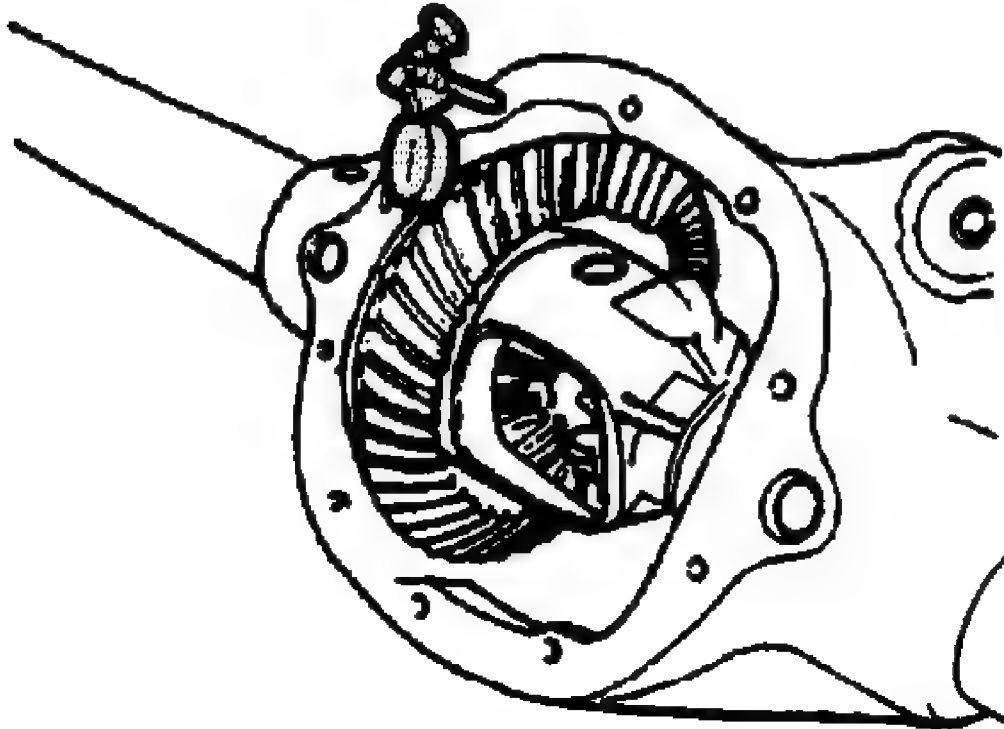


Fig. 85: Measuring Ring Gear Backlash
Courtesy of GENERAL MOTORS CORP.

1. Install the **J 25025-1** and the **J 8001** to the axle housing as shown.
2. Place the indicator stem of the **J 8001-3** at the heel end of a gear tooth.
3. Set the **J 8001-3** so that the stem is aligned with the gear rotation and perpendicular to the tooth angle.
4. Preload the dial of the **J 8001-3** .

Align the needle and the dial face of the **J 8001-3** to ZERO.

5. While holding the drive pinion stationary, move the ring gear back and forth.

Measure and record the backlash.

6. Repeat the measuring procedure at eight points around the ring gear.

Specification: The difference between the backlash at all of the measuring points

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should not vary by more than 0.05 mm (0.002 in).

7. If the difference between the backlash at all of the measuring points varies by more than 0.05 mm (0.002 in), inspect for the following conditions:
 - Burrs
 - A distorted case flange
 - Uneven bolting
8. If the difference between all the measuring points is within specifications, the backlash at the minimum lash point measured should be:

Specification: The backlash between the ring gear and the drive pinion should be between 0.08-0.25 mm (0.003-0.010 in) with a preferred backlash of 0.13-0.18 mm (0.005-0.007 in).

IMPORTANT:

- **Do not use the original cast iron production shims to adjust the backlash. Use service shims and spacers instead.**
 - **Adjust the thickness of the shim pack on each side of the differential in equal amounts. This will maintain the correct axle side bearing preload.**
 - **Moving 0.05 mm (0.002 in) of shim thickness from one side of the differential to the other will change the backlash adjustment approximately 0.03 mm (0.001 in).**
9. If the backlash is too small, increase the backlash using the following procedure:
 - A. Remove the bearing cap bolts and the bearing caps.

Mark the bearing caps left or right.
 - B. Remove the differential case assembly with the bearing cups and the shims.

Mark the bearing cups and the shims left or right.
 - C. Measure the thickness of left side shim pack.

Measure the production shim or the shim and service spacer in 3 locations.

Measure each shim separately.
 - D. Calculate the average of the 3 measurements for each shim.

Add the average of each of the shim measurements together.

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Record the measurement. This is the thickness for the left side shim pack.

- E. Assemble a new left side shim pack by decreasing the appropriate amount of thickness from the original left side shim pack. If the original shim is cast iron production shim, assemble the shim pack using a service spacer and service shims. For example, to increase the backlash by 0.05 mm (0.002 in), remove 0.10 mm (0.004 in) of thickness from the left side shim pack.
- F. Measure the thickness of right side shim pack.

Measure the shim or the shim and service spacer in 3 locations.

Measure each shim separately.

- G. Calculate the average of the 3 measurements for each shim.

Add the average of each of the shim measurements together.

Record the measurement. This is the thickness for the right side shim pack.

- H. Assemble a new right side shim pack by increasing the appropriate amount of thickness to the original right side shim pack. If the original shim is cast iron production shim, assemble the shim pack using a service spacer and service shims. For example, to increase the backlash by 0.05 mm (0.002 in), add 0.10 mm (0.004 in) of thickness to the right side shim pack.
10. If the backlash is too large, decrease the backlash using the following procedure:
- A. Remove the bearing cap bolts and the bearing caps.

Mark the bearing caps left or right.

- B. Remove the differential case assembly with the bearing cups and the shims.

Mark the bearing cups and the shims left or right.

- C. Measure the thickness of left side shim pack.

Measure the production shim or the shim and service spacer in 3 locations.

Measure each shim separately.

- D. Calculate the average of the 3 measurements for each shim.

Add the average of each of the shim measurements together.

Record the measurement. This is the thickness for the left side shim pack.

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- E. Assemble a new left side shim pack by increasing the appropriate amount of thickness to the original left side shim pack. If the original shim is cast iron production shim, assemble the shim pack using a service spacer and service shims. For example, to increase the backlash by 0.05 mm (0.002 in), add 0.10 mm (0.004 in) of thickness to the left side shim pack.
- F. Measure the thickness of right side shim pack.

Measure the shim or the shim and service spacer in 3 locations.

Measure each shim separately.

- G. Calculate the average of the 3 measurements for each shim.

Add the average of each of the shim measurements together.

Record the measurement. This is the thickness for the right side shim pack.

- H. Assemble a new right side shim pack by decreasing the appropriate amount of thickness to the original right side shim pack. If the original shim is cast iron production shim, assemble the shim pack using a service spacer and service shims. For example, to decrease the backlash by 0.05 mm (0.002 in), remove 0.10 mm (0.004 in) of thickness to the right side shim pack.
- 11. Install the differential case assembly with the bearing cups.
 - 12. Install the left side service spacer between the axle housing and the differential case.
 - 13. Install the right side service spacer between the axle housing and the differential case.

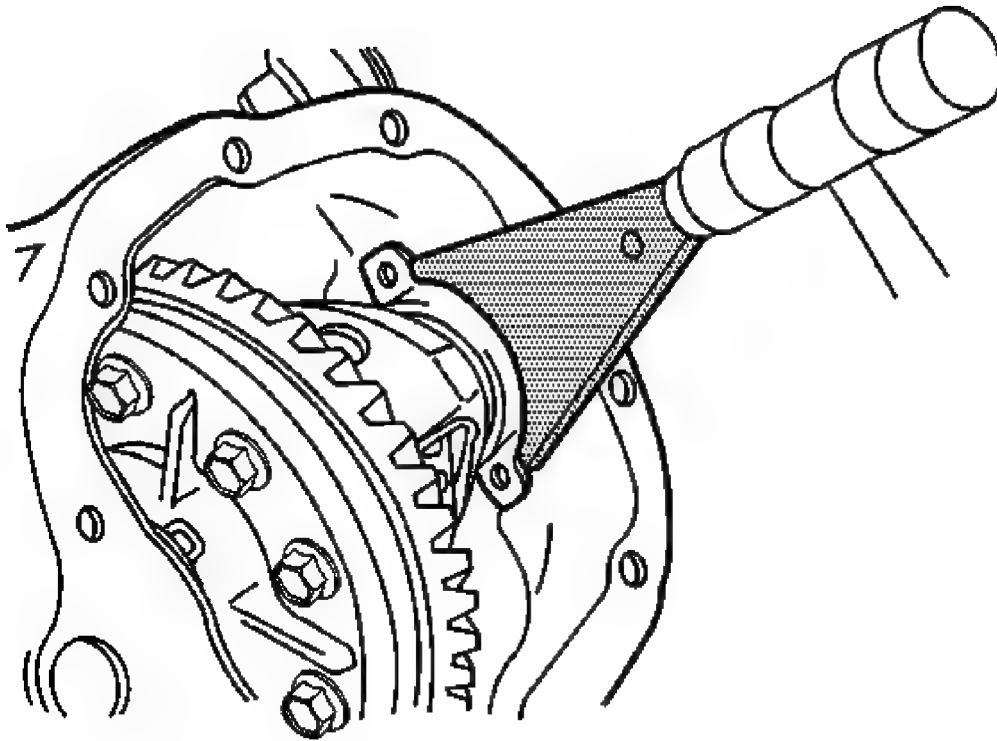


Fig. 86: Installing The Service Shim Using J 25588
Courtesy of GENERAL MOTORS CORP.

14. Install the left side service shim using the **J 25588** , if necessary.

The service shim must be installed between the service spacer and the differential bearing cup.

15. Install the right side service shim using the **J 25588** , if necessary.

The service shim must be installed between the service spacer and the differential bearing cup.

NOTE: Refer to Fastener Notice in Cautions and Notices.

16. Install the bearing caps and bolts.

Tighten: Tighten the bolts to 75 N.m (55 lb ft).

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17. Recheck the backlash and adjust, if necessary.
18. Once backlash is correct, perform a gear tooth contact pattern check in order to ensure proper alignment between the ring and pinion gears. Refer to **Gear Tooth Contact Pattern Inspection**.

GEAR TOOTH CONTACT PATTERN INSPECTION

The gear contact pattern check is not a substitute for adjusting the pinion depth and backlash. Use this method in order to verify the correct running position of the ring gear and the drive pinion. Gear sets which are not positioned properly may be noisy and/or have a short life span. A pattern check ensures that when best contact has been obtained between the ring gear and the drive pinion, the system will produce low noise and have a long life.

Drive Pinion and Ring Gear Identification

Production drive pinion and ring gears are manufactured by using a 2-cut or a 5-cut method. The 2-cut drive pinions and ring gears can be identified by having a groove cut into the outside edge of the ring gear and a ring on the stem of the drive pinion. The gear tooth contact patterns that are produced from each style of gear set differ slightly. A 2-cut gear will produce a pattern that is bias from the toe to the heel of the tooth (drive side), while a 5-cut gear set will produce a square pattern from the toe to the heel of the tooth (drive side). When diagnosing the gear tooth contact pattern, regardless of what type of gear set it is, a correct pattern will be centered within the area of the tooth, from toe to heel and from top to bottom.

Gear Tooth Nomenclature

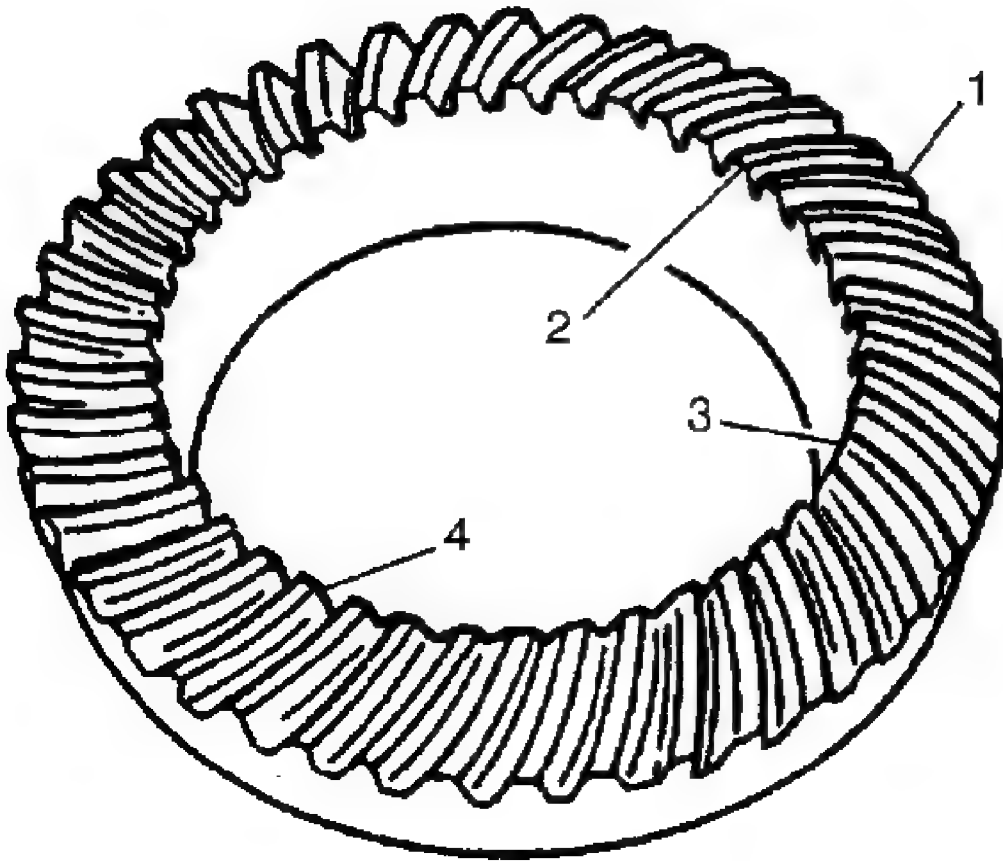


Fig. 87: Defining Gear Tooth Nomenclature
Courtesy of GENERAL MOTORS CORP.

The side of the ring gear tooth which curves outward, or is convex, is the drive side (4). The concave side is the coast side (3). The end of the tooth nearest the center of the ring gear is the toe end (2). The end of the tooth farthest away from the center is the heel end (1).

Adjustments Affecting Tooth Contact

The following 2 adjustments affect the tooth contact pattern:

- Backlash adjustment
- Pinion depth adjustment

The effects of bearing preloads are not readily apparent on hand-loaded tooth contact pattern tests. However, bearing preloads should be within specifications before proceeding with backlash and pinion depth adjustments.

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Backlash Adjustment

The backlash can be adjusted by either varying the thickness of the side bearing shims from side to side or by moving the adjuster sleeve(s) in or out, or both. By adjusting the shim thickness or moving the adjuster sleeve(s), the case and ring gear assembly will move closer to or further away from the pinion. In most cases, adjusting the backlash will correct an abnormal contact pattern. This adjustment will also be used to set the side bearing preload.

- If the thickness of the right shim is increased or the adjuster sleeve is moved in (if applicable), along with an equal decrease in the thickness of the left shim or the adjuster sleeve is moved out (if applicable), the backlash will increase.
- If the thickness of the left shim is increased or the adjuster sleeve is moved in (if applicable), along with an equal decrease in the thickness of the right shim or the adjuster sleeve is moved out (if applicable), the backlash will decrease.

Pinion Depth Adjustment

Adjust the position of the pinion by increasing or decreasing the distance between the pinion head and the centerline of the ring gear. Decreasing the distance moves the pinion closer to the centerline of the ring gear. Increasing the distance moves the pinion farther away from the centerline of the ring gear.

Testing Procedure

1. Wipe clean the differential case, the ring gear and the axle housing of lubricant. Carefully clean each tooth of the ring gear.

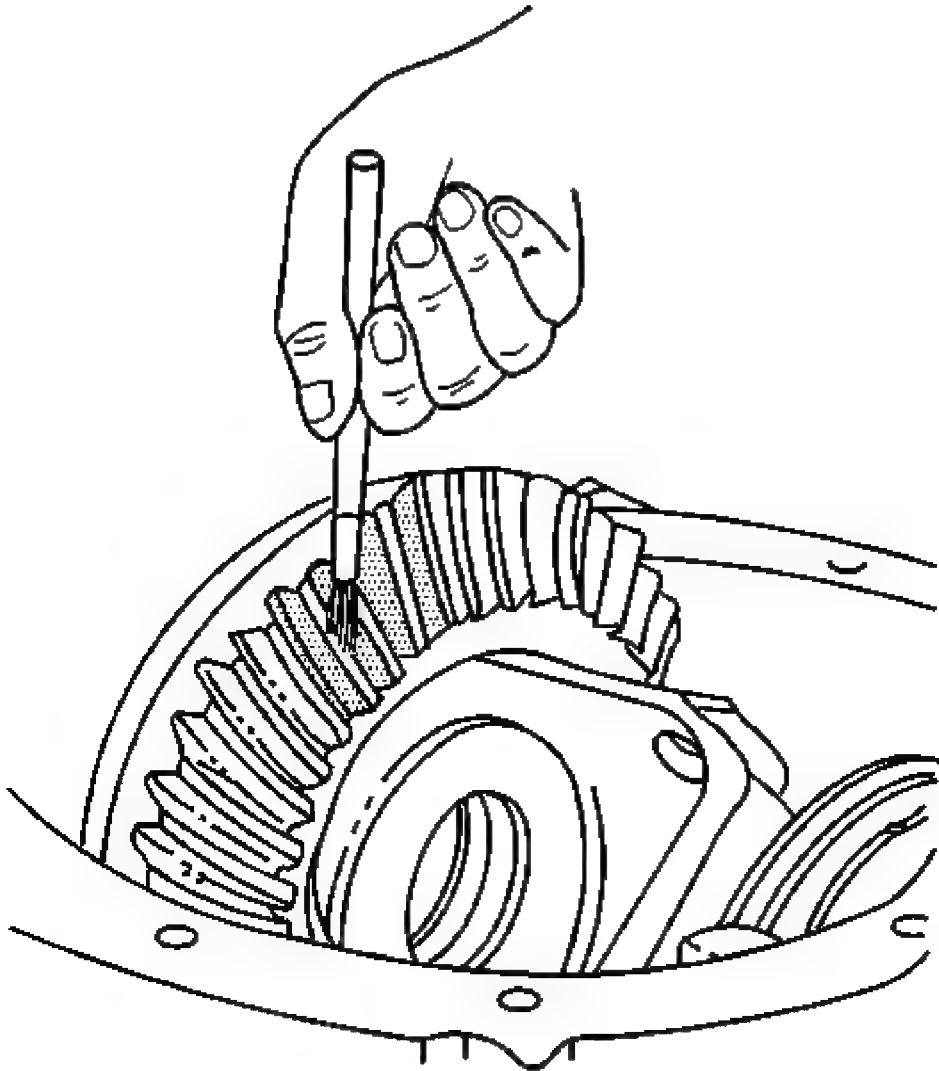


Fig. 88: Applying Gear Marking Compound To Ring Gear Teeth
Courtesy of GENERAL MOTORS CORP.

2. Use a medium stiff brush in order to sparingly apply gear marking compound, GM P/N 1052351 (Canadian P/N 10953497) or equivalent, to all of the ring gear teeth.
3. Torque the bearing caps bolts to specification.

IMPORTANT: Performing a test without loading the gears will not produce a satisfactory pattern.

4. Apply the park brake until a torque load of 14 N.m (10 lb ft) is required in order to turn

the pinion.

IMPORTANT: Avoid turning the ring gear excessively.

5. Using a wrench, turn the drive pinion flange/yoke so that the ring gear rotates 3 full revolutions.
6. Turn the drive pinion flange/yoke in the opposite direction so that the ring gear rotates 3 full revolutions in the opposite direction.
7. Observe the pattern on the ring gear teeth. Compare the pattern with the following illustrations.

Correct Contact Pattern

Condition

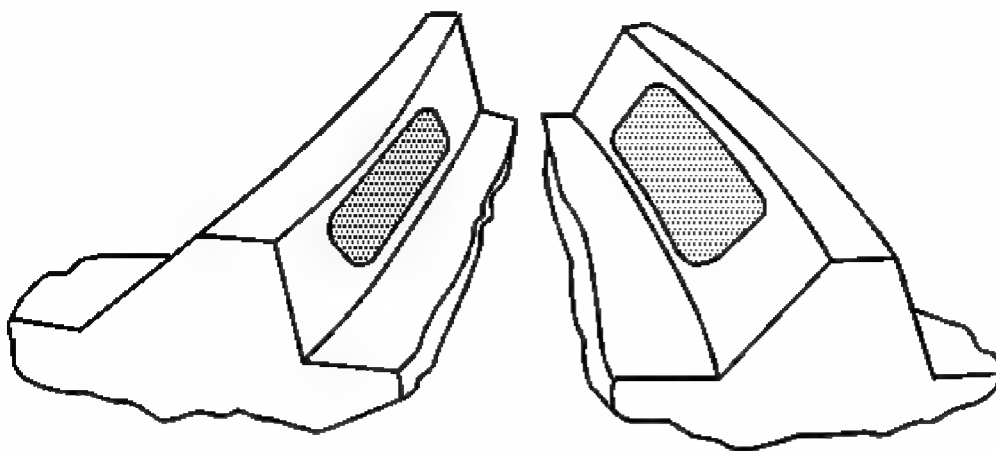


Fig. 89: Identifying Correct Gear Tooth Contact Pattern
Courtesy of GENERAL MOTORS CORP.

The backlash and pinion depth is correct.

Correction

None required.

Service Hints

Loose bearings on the drive pinion or in the differential case may cause patterns that vary. If

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the contact pattern varies, inspect the following preload settings:

- Total assembly
- Differential case
- Pinion

If these settings are correct, inspect for damage or incorrectly assembled parts.

Drive Side Heel - Coast Side Toe Contact Pattern

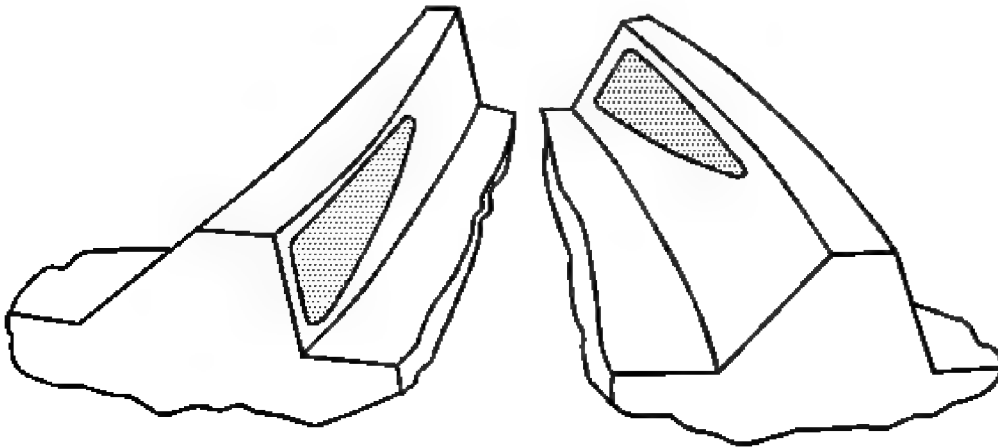


Fig. 90: Identifying Drive Side Heel - Coast Side Toe Contact Pattern
Courtesy of GENERAL MOTORS CORP.

Condition

The backlash is incorrect. The ring gear is too far away from the pinion.

Correction

Decrease the backlash. Move the ring gear closer to the pinion by adjusting the side bearing shim thickness or the adjuster sleeve(s). Refer to **Backlash Adjustment (7.6, 8.6 Inch Axle)**.

Drive Side Toe - Coast Side Heel Contact Pattern

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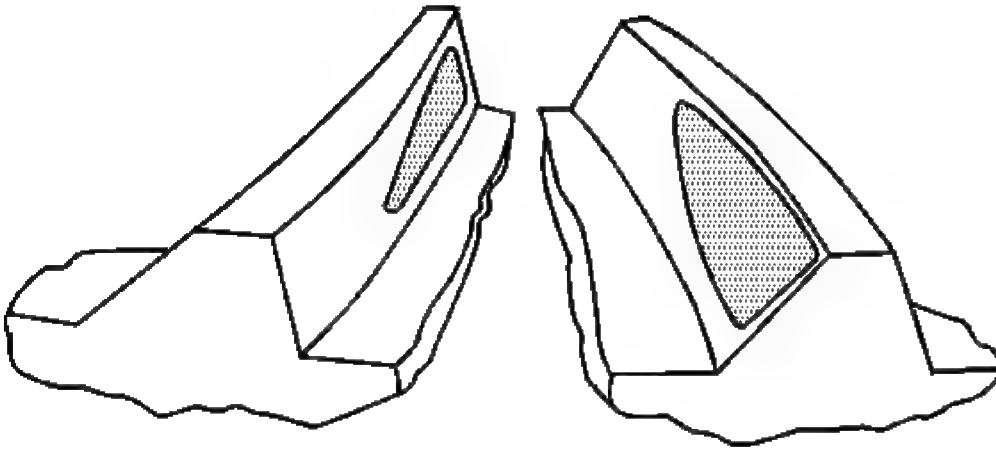


Fig. 91: Identifying Drive Side Toe - Coast Side Heel Contact Pattern
Courtesy of GENERAL MOTORS CORP.

Condition

The backlash is incorrect. The ring gear is too close to the drive pinion.

Correction

Increase the backlash. Move the ring gear away from the pinion by adjusting the side bearing shim thickness or the adjuster sleeve(s). Refer to **Backlash Adjustment (7.6, 8.6 Inch Axle)**.

Drive Side Heel - Coast Side Heel Contact Pattern

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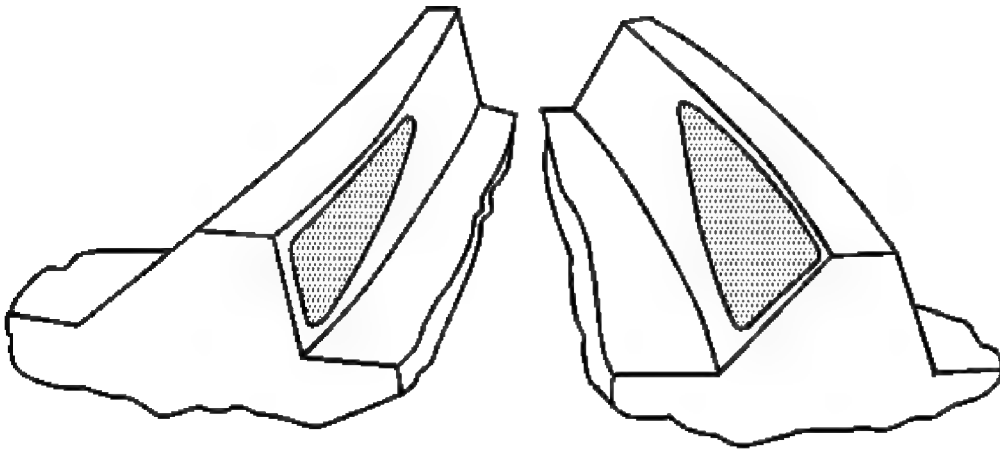


Fig. 92: Identifying Drive Side Heel - Coast Side Heel Contact Pattern
Courtesy of GENERAL MOTORS CORP.

Condition

The backlash is incorrect. The ring gear is too far away from the pinion.

Correction

Decrease the backlash. Move the ring gear closer to the pinion by adjusting the side bearing shim thickness or the adjuster sleeve(s). Refer to **Backlash Adjustment (7.6, 8.6 Inch Axle)**.

Drive Side Toe - Coast Side Toe Contact Pattern

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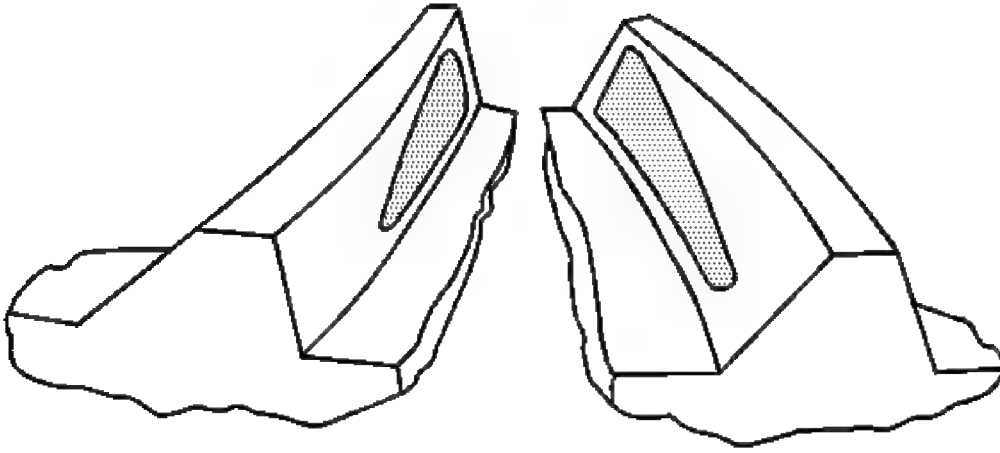


Fig. 93: Identifying Drive Side Toe - Coast Side Toe Contact Pattern
Courtesy of GENERAL MOTORS CORP.

Condition

The backlash is incorrect. The ring gear is too close to the drive pinion.

Correction

Increase the backlash. Move the ring gear away from the pinion by adjusting the side bearing shim thickness or the adjuster sleeve(s). Refer to **Backlash Adjustment (7.6, 8.6 Inch Axle)**.

High Flank Contact Pattern

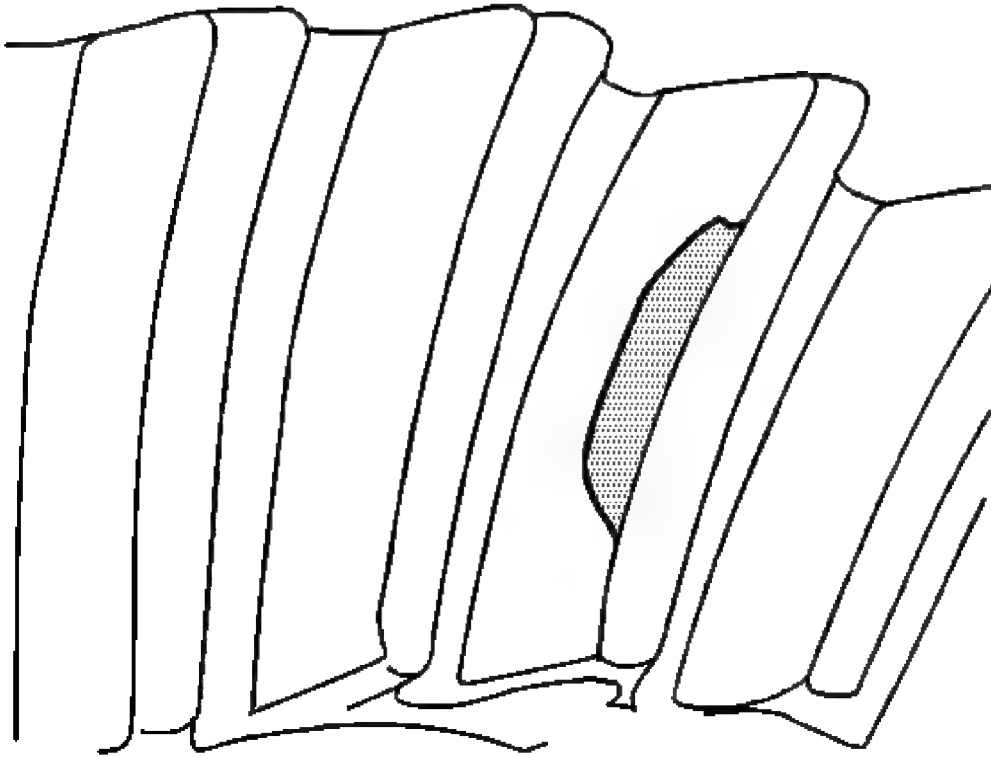


Fig. 94: Identifying High Flank Contact Pattern
Courtesy of GENERAL MOTORS CORP.

Condition

The pinion depth is incorrect. The pinion gear is too far away from the ring gear.

Correction

Increase the pinion depth. Move the pinion gear closer to the ring gear by increasing the pinion shim thickness. Refer to **Pinion Depth Adjustment**.

Low Flank Contact Pattern

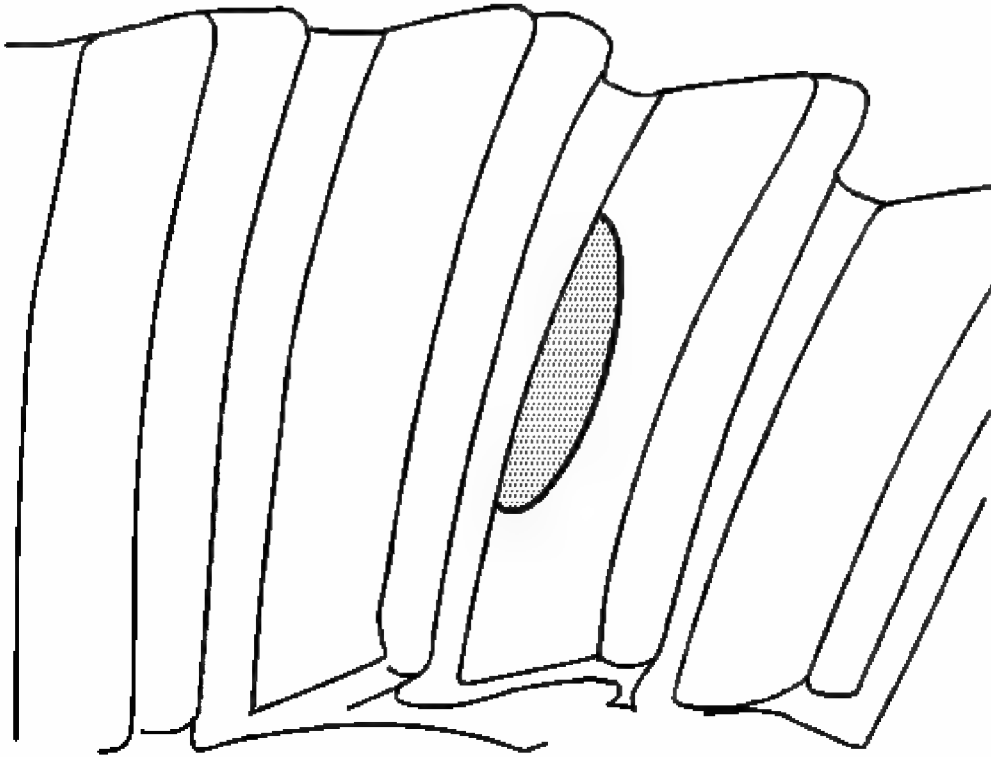


Fig. 95: Identifying Low Flank Contact Pattern
Courtesy of GENERAL MOTORS CORP.

Condition

The pinion depth is incorrect. The pinion gear is too close to the ring gear.

Correction

Decrease the pinion depth. Move the pinion gear away from the ring gear by decreasing the pinion shim thickness. Refer to **Pinion Depth Adjustment**.

DESCRIPTION AND OPERATION

REAR DRIVE AXLE DESCRIPTION AND OPERATION

Rear Axles for this vehicle consist of the following components:

- Differential axle housing
- Differential carrier

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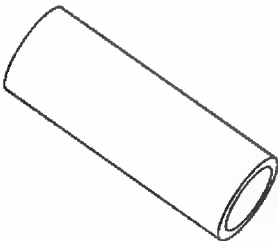
- Right and left axle tubes
- Right and left axle shafts

An open differential has a set of 4 gears. Two are side gears and 2 are pinion gears. Some differentials have more than 2 pinion gears. Each side gear is splined to an axle shaft so that each axle shaft turns when its side gear rotates. The pinion gears are mounted on a differential pinion shaft, and the gears are free to rotate on this shaft. The pinion shaft is fitted into a bore in the differential case and is at right angles to the axle shafts. Power is transmitted through the differential as follows: The drive pinion rotates the ring gear. The ring gear being bolted to the differential case, rotates the case. The differential pinion, as it rotates the case, forces the pinion gears against the side gears. When both wheels have equal traction, the pinion gears do not rotate on the pinion shaft because of input force on the pinion gear is equally divided between the 2 side gears. Therefore, the pinion gears revolve with the pinion shaft, but do not rotate around the shaft itself. The side gears, being splined to the axle shafts and in mesh with the pinion gears rotate the axle shafts. If a vehicle were always driven in a straight line, the ring and pinion gears would be sufficient. The axle shaft could be solidly attached to the ring gear and both driving wheels would turn at equal speed. However, if it became necessary to turn a corner, the tires would scuff and slide because the differential allows the axle shafts to rotate at different speeds. When the vehicle turns a corner, the inner wheel turns slower than the out wheel and slows its rear axle side gear (as the shaft is splined to the side gear). The rear axle pinion gears will roll around the slowed rear axle side gear, driving the rear axle side gear wheel faster.

SPECIAL TOOLS AND EQUIPMENT

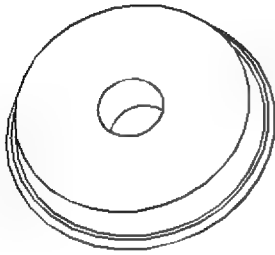
SPECIAL TOOLS

Special Tools

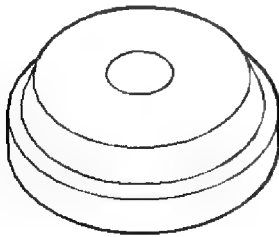
Illustration	Tool Number/Description
	J 2619-O1 Slide Hammer
	J 5590 Rear Pinion Bearing Race Installer

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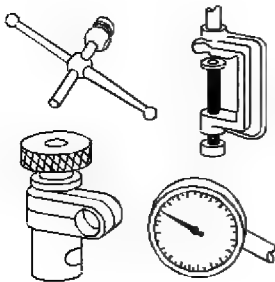
2004 DRIVELINE/AXLES Rear Drive Axle - Blazer/S10, Jimmy/Sonoma



J 7817
Outer Bearing Race Installer



J 7818
Rear Pinion Bearing Cup Installer



J 8001
Dial Indicator Set

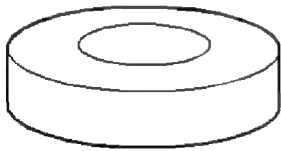
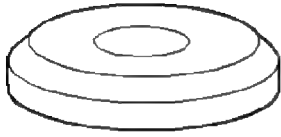


J 8092
Driver Handle

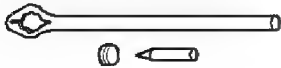
J 8608
Rear Pinion Bearing Race Installer

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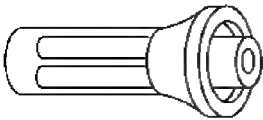
2004 DRIVELINE/AXLES Rear Drive Axle - Blazer/S10, Jimmy/Sonoma



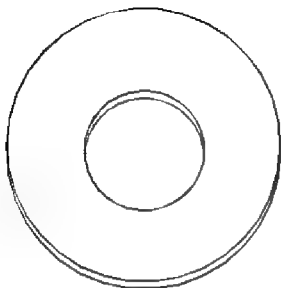
J 8611-01
Rear Pinion Bearing Race Installer



J 8614-01
Flange/Pulley Holding Tool



J 21128
Axle Pinion Oil Seal Installer

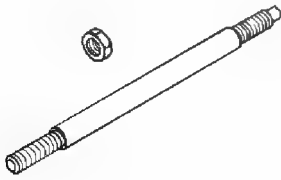
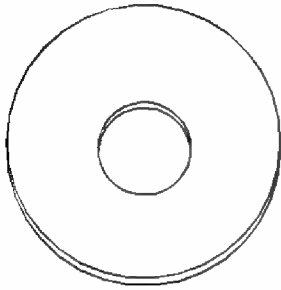


J 21777-40
Rear Pilot Washer

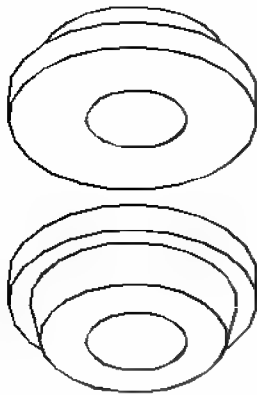
J 21777-42
Front Pilot Washer

2004 Chevrolet S10 Pickup

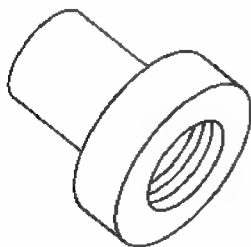
2004 DRIVELINE/AXLES Rear Drive Axle - Blazer/S10, Jimmy/Sonoma



J 21777-43
Stud Assembly Bolt



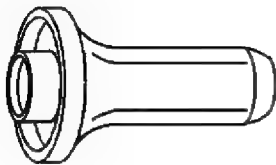
J 21777-45
Side Bearing Discs



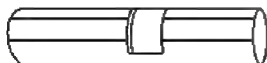
J 21784
Side Bearing Installer

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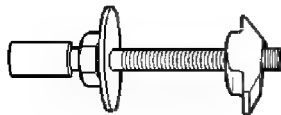
J 22388
Pinion Oil Seal Installer-Rear



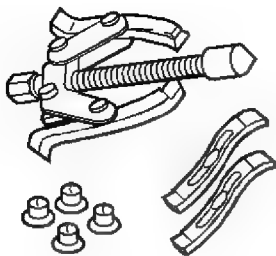
J 22536
Pinion Driver



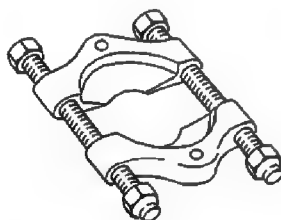
J 22779
Side Bearing Backlash Gage



J 22813-01
Axle Bearing Remover/Installer



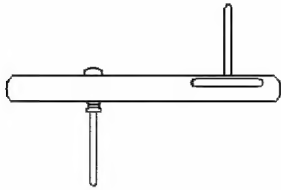
J 22888-D
Side Bearing Remover Kit



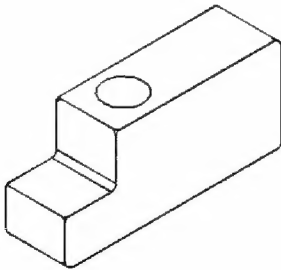
J 22912-O1
Split Plate Bearing Puller

2004 Chevrolet S10 Pickup

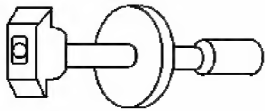
2004 DRIVELINE/AXLES Rear Drive Axle - Blazer/S10, Jimmy/Sonoma



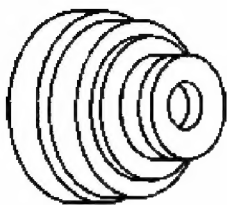
J 23597-1
Arbor



J 23597-11
Gage Plate



J 23689
Axle Shaft Bearing Remover (Large Shaft)

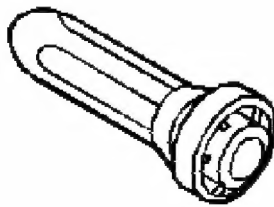
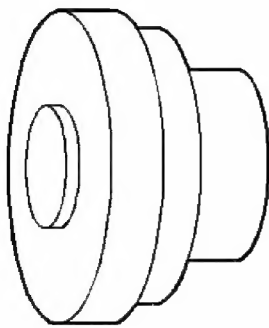


J 23690
Axle Shaft Bearing Installer

J 23765
Axle Shaft Bearing Installer

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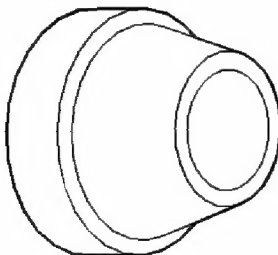
J 23771
Rear Axle Shaft Oil Seal Installer



J 24433
Pinion Cone and Side Bearing Installer



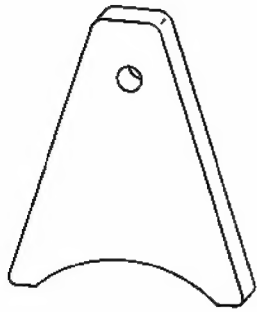
J 25025
Guide Pins



J 25299
Side Bearing Installer

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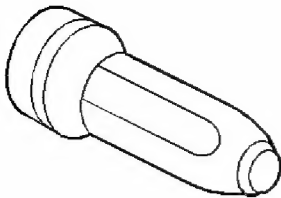
2004 DRIVELINE/AXLES Rear Drive Axle - Blazer/S10, Jimmy/Sonoma



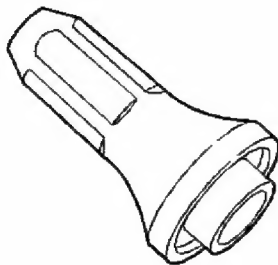
J 25588
Side Bearing Shim Installer



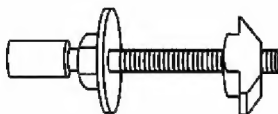
J 29609
Rear Pinion Bearing Cup Installer



J 33782
Pinion Oil Seal Installer



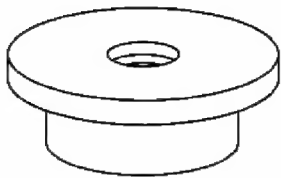
J 38694
Extension Housing Oil Pump/Seal Installer



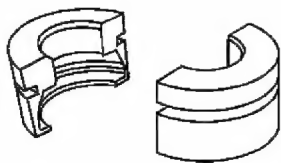
J 44685
Rear Axle Seal and Bearing Remover

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J 45870
Pinion Bearing Cup Installer



J 45871
Pinion Bearing Remover